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MANUAL OF TREE AND SHRUB INSECTS

A General Account of the More Important or Common Insects Attacking Shade and Forest Trees and Shrubs and Woody Ornamentals

BY

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STATE ENTOMOLOGIST OF NEW YORK

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PREFACE

We should not overlook the insects when planning for the better protection of forest and other trees.

It is the purpose of this volume to give a readable and practical summary of the insect problem in its relation to both forest and shade trees. The writer has been keenly interested in this phase of entomology for over thirty years. There have been many valuable contributions to our knowledge of forest insects by various workers within the nearly twenty years which have elapsed since the author's "Insects Affecting Park and Woodland Trees" appeared as Memoir 8 of the New York State Museum, not to mention the introduction in this country of a number of important tree enemies and the marked progress in control work during this period. The insect problems in relation to trees are likely to become more serious, if one may judge from the developments of the past twenty-five years.

The illustrations in this volume are reprinted in large measure from the author's earlier works, most of them having been executed by the late L. H. Joutel, one of our gifted delineators of insect life. A number of photographs or figures have been reproduced through the courtesy of the following: Dr. L. O. Howard, Dr. A. D. Hopkins and Mr. A. F. Burgess of the Federal Bureau of Entomology, Professor C. R. Crosby of Cornell University, Dr. W. E. Britton, State Entomologist of Connecticut, Professor J. S. Houser of the Ohio Agricultural Experiment Station and Professor E. O. Essig of the University of California; to all of whom due acknowledgments are made.

E. P. Felt.

Albany, N. Y.
June 1, 1923.

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A general account of the nature and transformation of insects, their place and balance in the world of living things, the checks that have arisen in the course of time, and the means by which man has learned to control them, together with a citation of important literature.

MANUAL OF TREE AND SHRUB INSECTS

CHAPTER I

PRELIMINARY INFORMATION

There is nothing more attractive and characteristic than a well-grown tree or a group of trees on the lawn, in a park, along the streets of cities or villages and in the forest. There is an inspiration in a perfect specimen or group of trees which appeals to the best in man. The cities and villages of America have a glorious heritage in their trees, the result of wise and loving planting by earlier generations.

. The last fifty years or thereabouts have witnessed the introduction of a number of destructive tree pests, such as the elm leaf-beetle, the gipsy moth and the leopard moth, while native insects, like the white-marked tussock moth, the bagworm and the sugar maple borer, have not been slow to take advantage of extensive and reliable food supplies provided by city and village trees with the accompanying considerable protection from insectivorous birds. These somewhat recent developments have resulted in a gradual increase in insect depredations which for the most part have been regarded as inevitable. A careful examination of our trees at the present time shows the effect in a lamentable scarcity of perfect specimens, many of them with appreciable injury and not a few seriously deformed as a result of insect work. The operations of the sugar maple borer are particularly insidious, since a period of five to ten years may elapse between an apparently insignificant injury and the death of a considerable proportion of a symmetrical maple before its prime.

The long period between planting and the attainment of maturity renders trees particularly susceptible to insect attack. It requires a generation to produce even a moderate-sized tree, while the stately monarchs on lawns and in parks may have complacently viewed the passing of five or six human generations. Tree hazards are immensely greater than they were fifty years ago, and those who have benefited by the foresight of predecessors should recognize this and take precautions which will make it possible to hand down an unimpaired inheritance. This can be done by recognizing the dangers and anticipating injury, rather than by attempting to reshape badly deformed trees or reinvigorate those which have been devitalized, though such methods have a place in attempting to remedy the earlier injuries.

The acceptance of insect ravages as inevitable is an inheritance from an age which knew little or nothing of arsenical poisons and had no knowledge of spraying apparatus better than a whisk-broom or a hand pump designed for the washing of windows. Generally speaking, insect depredations may be prevented. This is particularly true of the more valuable trees on lawns and in parks and to a smaller extent in the case of woodland areas, though much can be accomplished in bettering the forest situation by modifying the conditions which affect the abundance of insects and especially by protecting some of the most efficient insect enemies, the birds.

The severe injury by the gipsy moth showed the need of systematic protection of trees, and Massachusetts has made provision for the appointment of tree wardens in the towns of that state. The trees of a number of cities in the eastern United States at least are in charge of shade tree commissions or city foresters and are in much better condition than they were a few years ago.

A number of tree-protecting firms have been organized and are operating in various parts of the country. Some are doing most excellent work. Others, with less regard for the future, have in the past done much scraping of the rough bark from trunks, a very questionable procedure so far as the welfare of the tree is concerned. Many communities would welcome reasonable moderate-riced protection for trees, a service which can be rendered by local parties possessing some knowledge of trees and the ability to operate efficient spraying outfits.

The Parts of an Insect

An insect is a six-legged tracheate animal with the principal body divisions, namely, head, thorax and abdomen, separate. The insect may be distinguished from the closely related spiders, because adults of the latter have eight legs and the head and thorax are fused into a compound cephalothorax. The related adult mites have eight legs and may be recognized by the unsegmented abdomen being fused with the thorax. The large number of legs in centipedes and millipedes, together with their elongate form, should prevent their being confused with insects.

The head of the insect bears the principal sense organs, the eyes and the antennæ and also those for the prehension and mastication of food, the latter consisting of the mandibles, the maxillæ with their palpi and the lower lip or labium, the last also provided with palpi.

The thorax bears the principal organs of locomotion, the wings and the legs.

Wings may be absent in some cases, as in the primitive Thysanura, and in certain sexes and some species of the higher orders. The wings may be almost veinless, as in some tiny parasites or with a large number of veins as in most may-flies. They may be clothed with hairs as in some flies or thickly covered with scales as in the butterflies and moths. The fore-wings may be modified to form protective shields, the wing-covers of beetles, or basally thickened, as in the anterior wings of the Heteroptera or true bugs, and to a still less extent in many grasshoppers or Orthoptera. The modifications of these organs are of great aid in classification. The hind-wings may be reduced to mere vestiges, known as halteres or balancers, as in the flies.

There are normally six legs, although occasional species have but four, the anterior two in some butterflies being reduced to mere rudiments. Some very degenerate forms, females of certain scale insects, have no legs. The principal parts of the leg are the trochanter, femur, tibia and tarsus. The first is the small segment close to the body, the femur and tibia are usually of nearly equal length, the former stouter, while the tarsus is rather slender and usually consists of three to five segments, the terminal one bearing a pair of claws or a sucking disk or both. There are considerable modifications in each of these parts and their relative development, length, clothing and color are much used in classification.

The abdomen has ten or fewer segments and is usually considerably longer than the harder, more complex thorax. It is composed of a series of very similar segments, the terminal ones bearing the sexual organs, which are very diverse in different orders and families, and sometimes present considerable differences in related species.

The larvæ of insects diverge greatly from the normal structure and occasionally appear to lack important organs. The head is usually present, the eyes are simple, though sometimes absent, the antennæ are often very minute and the wings are wanting, as is also the case with the true legs in many families. The abdomen is relatively much longer and in certain groups at least is provided with false legs or prolegs, which are of material service in locomotion. It may be stated as a general rule that the larvæ of some of the highly developed insects are the most helpless degraded forms, being dependent on the mother to place the egg or the young where food is of easy access, or else it is possible for them to attain maturity only through paternal aid, which in some instances is bestowed by a nurse form. Larvæ of the more lowly or less specialized insects are better able to provide for themselves and many of them are relatively well equipped to meet the struggle for existence, some being more powerful than the adult. This last is particularly true of the mayflies.

Transformations of Insects

It is well known that insects exist in various stages, namely, the egg, the larva variously known as caterpillar, maggot, grub and erroneously termed a worm, the pupa or chrysalis, and the adult or perfect insect. Development always follows this sequence, although the cycle is variously modified in certain forms. For example, the egg stage may be suppressed and the young produced alive, as in the case of certain blow flies and their allies; there may be an indeterminate series of parthogenetic generations as in the case of many aphids or green lice; or pedogenetic generations, that is, larvæ producing larvæ in certain small midges; all are adaptations favorable to the existence of the various species.

Generally speaking, all insects develop from eggs. These are frequently of exceedingly beautiful design. They may be placed in clusters, bunches or singly on or in leaves, bark, food products, and the like, tucked in all manner of crevices, dropped at random in the grass or buried in the soil. They may be arranged in single or double rows, in bands about a twig, left unprotected or covered with hairs or scales or sheltered by a gummy or wax-like excretion. The duration of the egg stage may vary from a few days to nearly a year.

The term "larva" is applied to the young of insects having a complete and incomplete metamorphosis and is frequently limited to those of the former class commonly known as caterpillars, grubs and maggots. The larval stage is the period of growth and it is while in this form that most injurious insects commit their depredations. Growth is possible only by a series of molts and shedding of the relatively inelastic old skin and especially the head case, and the development beneath of a new and larger integument. An impending molt is indicated by the larva neglecting its food and appearing dumpish, and is followed later by a retraction of the head from its old case and a swelling of the thoracic segments. Soon the old skin splits over the newly developed head case and the caterpillar slowly emerges, leaving the old skin in a collapsed, shrivelled condition. One of the readiest methods of ascertaining whether a molt has taken place is to look for the empty head case or to measure the width of the head, since a marked increase in diameter usually indicates a molt.

All larvæ, generally speaking, have a distinct head, well-developed mouth-parts, simple eyes, six thoracic legs and an abdomen destitute of true legs. The membranous pro-legs of Hymenopterous, Coleopterous and Lepidopterous larvæ are secondary developments to meet the necessities of existence and vary in number from a large anal one among the grubs of many beetles to sixteen in some sawflies. The larvæ of some of the more highly developed insects, such as bees and flies, are legless and have a very small head and poorly developed mouth-parts.

A knowledge of the immature stages is of much importance to the economic entomologist because most insects are injurious during the larval existence. Sawfly larvæ may be recognized by their usually cylindrical form and the twelve to sixteen pro-legs in addition to the six true or thoracic legs, while caterpillars, the young of butterflies and moths, are usually provided with four to ten pro-legs in addition to the six true legs. Most of the young of beetles or grubs possess six thoracic legs and are often provided with a fleshy appendage at the posterior extremity.

The transformation to the adult is preceded by the assumption of the pupal form. This may occur in the open, as in the case of the chrysalids of butterflies, within a more or less elaborate cocoon as in many moths or in an underground cell as with a number of moths and many beetles. The pupa is usually conical or subconical in form with the rudimentary antennæ, wings and legs closely appressed to the breast. It may be concealed by the last larval skin which usually turns brown, hardens and then is known as the puparium, a structure common with many of the more specialized flies. The unsheltered pupæ of many beetles are protectively colored.

The adult or imago stage is not marked by growth. Flies of various sizes, as a rule, belong to different species. The larger are never parents of the smaller. Some mature insects take no food in the adult condition. A few moths are wingless and merely emerge, deposit their eggs in a few days and die, although the larger number consume enough to maintain life for a longer period. The main object of adult existence is to provide for the perpetuation of the species and death usually follows soon after. This stage is marked by the greatest diversity of form, and a study of the perfect insects, in particular the relation of one to another, forms the basis of systematic entomology. The elaborate classifications now recognized are not the work of one man or even of a generation but represent the combined efforts of many students from the time of Linnæus to the present.

The winter is a period of comparative quiet, and little is seen then of insect life in temperate latitudes. Insects winter in all stages, the egg, the larva, the pupa and the adult, though each species is usually closely restricted in its manner of hibernation. Considerable series of insects winter successfully in the egg stage. Not a few partly grown caterpillars pass the dormant period in sheltering grass or within cleverly concealed silken cases on twigs or branches. The silken cocoons upon trees, near sheltered places or the earthen cells, are also well-known winter retreats for many species. Beetles, bugs and even delicate moths and butterflies can withstand extreme cold and some forms are apparently able to survive the winter in either the larva, pupal or adult condition. It is a well-known fact that caterpillars may be frozen stiff and revive, though they are very likely to perish if this is repeated several times.

The marked changes outlined above are not true of all insects. Some of the lowest and simplest, such as the snow fleas, slides or silver-fish, the Thysanura and their allies, undergo no transformation, i.e., there is very little or no difference except in size between recently hatched young and adults.

Grasshoppers and related insects have what is known as an incomplete metamorphosis or transformation, which means that there is a gradual development through a succession of active stages to the adult. The immature individuals are frequently spoken of as nymphs and the best authorities limit this term to the young of species having an incomplete metamorphosis. The development of grasshoppers is a common and typical illustration of incomplete metamorphosis.

The greatest changes in development are seen in insects, as moths, butterflies and beetles which undergo a series of marked changes, such as from the active caterpillar or maggot to the quiet pupa or puparium and then the beautiful moth or butterfly, the differences between these stages being so marked that little in the way of a general resemblance can be discerned. A very large proportion of insects undergo a complete metamorphosis, and special knowledge of the immature stages is almost necessary to the ready identification of many destructive species.

Origin of Insect Pests

The balance of nature is really a very unstable state of equilibrium readily disturbed by the massing of food plants, the introduction of new species and a reduction in the number of natural enemies, such as birds and parasites. An insect injurious under one set of conditions may be extremely rare in another environment, and the scourge of the present may be noteworthy for its absence ten to twenty years hence. There are variations not only from year to year but from month to month and also within much narrower limits, a striking difference occasionally following marked climatic changes.

The insect enemies of American shade trees have come largely from two sources, namely, native forest insects which have found in shade trees unusually favorable conditions for multiplication, such as the fall webworm, the spiny elm caterpillar and the bronze birch borer, and the species accidentally brought in from other countries. A very considerable proportion of the most important agricultural pests are introduced species and the same is true of the insect enemies of shade trees and ornamentals. This is well illustrated by the following list.

Introduced Shade Tree and Ornamental Pests

Borers and Wood Gnawers

Leopard moth, *Zeuzera pyrina* Linn.
European Lyctus, *Lyctus linearis* Goeze.
European elm bark-beetle, *Scolytus multistriatus* Marsh.

Mottled willow borer, *Cryptorhynchus lapathi* Linn.
European pine shoot moth, *Evetria buoliana* Shiff.
Rose stem-girdler, *Agrilus viridis* Linn.
European hornet, *Vespa crabro* Linn.

Leaf-Feeders

Gipsy moth, *Porthetria dispar* Linn.
Brown-tail moth, *Euproctis chrysorrhœa* Linn.
Elm leaf-beetle, *Galerucella xanthomelæna* Schrank.
European elm case-bearer, *Coleophora limosipennella* Dup.
Elm leaf-miner, *Kaliofenusa ulmi* Sund.
Imported willow leaf-beetle, *Plagiodera versicolora* Laich.
Satin moth, *Stilpnotia salicis* Linn.
Poplar sawfly, *Trichiocampus viminalis* Fabr.
Larch case-bearer, *Coleophora laricella* Hubn.
Bristly rose slug, *Cladius pectinicornis* Fourc.
Coiled rose slug, *Emphytus cinctus* Linn.
Box leaf-midge, *Monarthropalpus buxi* Lab.
Imported pine sawfly, *Diprion simile* Hartig.
Larch sawfly, *Nematus erichsonii* Hartig.

Sucking and Other Insects

Spruce gall-aphid, *Chermes abietis* Linn.
European willow gall-midge, *Rhabdophaga salicis* Schrk.
Woolly larch aphid, *Chermes strobilobius* Kalt.
Rose aphis, *Macrosiphum rosæ* Linn.
Woolly beech leaf-aphid, *Phyllaphis fagi* Linn.
Elm bark-louse, *Gossyparia spuria* Modeer.
Oyster-shell scale, *Lepidosaphes ulmi* Linn.
Rose scale, *Aulacaspis rosæ* Bouché.
San José scale, *Aspidiotus perniciosus* Comst.
Golden oak scale, *Asterolecanium variolosum* Ratz.
Camphor scale, *Pseudaonidia duplex* Ckll.
Spruce bud-scale, *Physokermes piceæ* Schr.
Norway maple leaf-hopper, *Alebra albostriella* Fall.
Laurel psyllid, *Trioza alacris* Flor.

Literature

There have been considerable additions to the literature of forest entomology during recent years, although the work of the pioneers in this branch of the science—Asa Fitch, of New York state, and A. S. Packard, formerly of the United States

Entomological Commission—can not be overlooked. These men have had able successors in A. D. Hopkins, of the United States Bureau of Entomology, and his associates. A number of the more important works on American entomology are listed below.

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CHAPTER II

NATURAL CHECKS AND METHODS OF CONTROL FOR INJURIOUS INSECTS

Insect life is so prolific and varied that it would speedily overrun the world if it were not for various natural checks or controlling agencies.

Adverse climatic conditions, such as extremes in temperature, moisture and light affect all insects, some of which thrive best under one series of conditions and others under another. A general knowledge of the relation of climate to outbreaks by various insects is of material service in forecasting probabilities. The chinch bug, for example, becomes numerous in the drier sections of the country, many plant-lice thrive in somewhat cool spring weather and elm leaf-beetles are greatly reduced by persistent cool wet weather.

Aside from the above, probably no agents are more effective than birds and particularly is this true in relation to forest insects. There appears to have been within the last twenty or twenty-five years a marked increase in the depredations by native leaf-eating forest caterpillars in the northeastern United States and it is perhaps significant to note that this has been accompanied or preceded by a marked decrease in the number of native birds. The indiscriminate destruction of these beneficial forms should receive more attention on account of the material service birds render in destroying numerous leaf-eating caterpillars and boring grubs, even if one is blind to æsthetic considerations and ignores the appeal of a numerous and varied bird life.

Parasitic and predaceous insects are exceedingly important in controlling insect outbreaks and occasionally they may be the principal agents in reducing the numbers of a serious pest.

There are entire families of parasitic insects, many of which work internally and are easily reared from their hosts. The true parasites belong to several families of the four-winged flies or Hymenoptera and to one in the Diptera. Many of the largest and most important parasites are found in the Ichneumonidæ, a very large group containing species of Pimpla, Ophion, Rhyssa and others distinguished by their wasp-like appearance and by having the abdomen usually flattened as though by pressure from above and with the first abdominal segment bent at nearly right angles, although certain species have the abdomen strongly compressed; that is, flattened as though by pressure from each side. The Chalcididæ and the Proctotrypidæ comprise long series of minute exceedingly valuable parasites, many in the latter family being egg parasites and so small that they can obtain their entire sustenance from such a small object as the speck-like egg of the codlin-moth.

Practically all of the Dipterous parasites belong to the Tachinidæ, a large family containing numerous forms having much the appearance of the common housefly and presenting remarkable variations in habit. They are more general in their food habits than most of the Hymenopterous parasites and frequently attack insects belonging to very different groups.

There are considerable series of predaceous insects which render material service in checking injurious species. The ground beetles or Carabidæ, a large series of very similar forms, are mostly predaceous in habit and some are known to be exceedingly efficient insect enemies.

The checkered beetles or Cleridæ occur very commonly on forest trees infested with various bark and wood-borers and it is by no means uncommon to find their reddish brown-headed grubs in the burrows of bark-borers.

The lady beetles or Coccinellidæ are common and voracious enemies both of plant-lice and scale insects, the adults and young feeding readily on these plant pests. An abundant infestation of plant-lice or scale insects is usually followed shortly by the appearance of many lady beetles and their young, and in not a few instances the outbreaks are speedily checked by these beneficial insects.

The flower flies or Syrphidæ are represented by numerous bright-colored, frequently yellow-marked, moderate-sized flies which deposit their eggs upon aphid infested foliage, the varicolored, frequently greenish and reddish marked maggots quickly devouring hosts of the pests. This group rivals the lady beetles in controlling aphid outbreaks.

Certain plant bugs, somewhat triangular, yellowish or yellowish-brown, moderate-sized insects belonging to the genera Podisus and Euschistus, are sometimes abundant and prey very effectively upon leaf-eating insects, such as the apple tent-caterpillar.

The Southern praying Mantis, *Stagmomantis carolina* Linn., and the recently established European praying Mantis, *Mantis religiosa* Linn., are both well-known predaceous forms which do not hesitate to prey upon a great many insects.

Selection and Planting of Resistant Trees

The abundance of serious insect enemies makes it advisable to consider the resistance of certain trees to insect injury before planting them upon streets or in parks. The sugar maple and the American elm have been general favorites as street trees in the northeastern United States at least, the latter being a somewhat unfortunate selection in areas in which the elm leaf-beetle became established in numbers. All too frequently most of the trees in a community are limited to one species, a condition very favorable to injury when a destructive insect becomes established. It is a well-recognized principle that large areas devoted to a single crop, especially for a series of years, increase the danger from insect enemies, a condition very true of both fruit and shade trees. It would be much better if different varieties were alternated on the same street or at least set in small groups so that, in case a few became badly infested by a somewhat local pest, such as the white-marked tussock moth or the elm leaf-beetle, there would be appreciable obstacles to their establishing themselves upon other trees.

As a guide to the selection of street trees, the following list has been prepared. The figure 3 indicates practical immunity, 2.5, some damage, 2, trees having one somewhat serious enemy, 1.5, those having at least one notorious pest, and greater probabilities of injury are indicated by 1 and still more by .5.

Tulip tree	3
*Tree of Heaven	3
Gingko	3
Hardy catalpa	2.5
Red oak	2.5
Scarlet oak	2.5
Yellow oak	2.5
Oriental plane tree	2.5
American plane tree	2.5
Sycamore maple	2.5
Norway maple	2
Sugar maple	2
White oak	2
Bur oak	2
Red maple	2
Honey locust	2
European linden	1.5
American linden	1.5
Horse-chestnut	1.5

Soft or silver maple	1.5
American elm	1
*Hackberry	1
European elm	.5
Scotch elm	.5
Cottonwood	.5
Balm of Gilead	.5
Black locust	.5

Those that are starred have been seen only in parks or in such small numbers that the rating can be regarded as provisional only.

Control and Remedial Measures

The possibilities of direct control methods against insects occurring upon shade and park trees justify measures which could not be recommended for ordinary forest areas except under very unusual conditions, consequently it is necessary to distinguish clearly between the two. The following general discussions relate in particular to the more valuable trees of roadsides and parks and apply to only a very limited extent to ordinary forest areas.

Biting and sucking insects.

It is necessary at the outset to distinguish between these two groups, because the former actually consume or ingest tissues and consequently may be destroyed by the application to the foliage or other tissues attacked of a poison, such as arsenic in some form, which acts internally. On the other hand, there are numerous sucking insects which draw their nourishment from the underlying tissues through an extremely small beak and are consequently unaffected by the comparatively inert particles of poison, such as arsenic, lying upon the surface of the leaves or other parts of affected plants.

Biting insects ordinarily may be destroyed with internal poisons, provided the insecticide can be placed where the pests must eat it or go hungry. This latter is of importance, since many leaf-feeders distinguish to a greater or less extent between poisoned and unpoisoned foliage.

The sucking insects can be destroyed successfully only by the application of some contact insecticide; that is, a material containing a powerful irritant or corrosive which will destroy by external action, such as nicotine sulfate or the various lime sulfides occurring in the generally used lime-sulfur wash, or a material which will spread over the insect and smother it to death by preventing air gaining entrance to the spiracles, as, for example, a mineral or vegetable oil or an emulsion of the same. In other words, effective treatment against sucking insects is conditioned on ability to throw a contact insecticide upon the insect.

There are exceptions to the above and variations in habit which must be taken into account. Some insects are very resistant to poisons, although as a rule the difficulty is likely to be a lack of thoroughness in treatment. Many biting insects, such as leaf-miners, twig-, bark- and wood-borers, work in places where it is impracticable to poison them. Others feed underground and must be fought in special ways.

Sucking insects also present problems. Some are so well protected, such as scale insects and certain plant bugs, that it is well-nigh impossible to kill them with preparations which will not also injure the plant. The attacks of many plant-lice cause the leaves to curl so that it is difficult to hit them with a spray and others are well protected by masses of waxy cottony matter. Certain small leaf-hoppers are exceedingly active and not easily reached with any spray.

The problem of the economic entomologist is to develop practicable control methods in the case of all injurious species. This is usually possible with a full knowledge of the habits and limitations of the different pests.

Insecticides.

Arsenate of lead is very generally used as a poison, as it is one of the most adhesive and there is little danger of burning the foliage, even if applied in somewhat excessive amounts. Most leaf-feeders succumb to spraying with six pounds of the paste (three pounds of powder) to 100 gallons of water, though in the case of the gipsy moth ten pounds of paste are ordinarily recommended.

Paris green and london purple are two of the oldest and most widely used insecticides, although at present they are rarely applied to shade and park trees except when there is a very serious infestation and, therefore, urgent need for destroying the caterpillars speedily. These poisons work more quickly than arsenate of lead and may be used at the rate of one pound with an equal amount of recently slaked lime to 100 gallons of water.

There are material advantages in early applications of poisons, since young caterpillars succumb more quickly than older ones and there is also less likelihood of material damage to the foliage.

Tobacco is a favorite and most effective insecticide. A concentrated standardized tobacco solution, such as nicotine sulfate, 40 per cent nicotine, is the preferred form. It should be used at the rate of three-quarters of a pint to 100 gallons of water together with six to eight pounds of any cheap soap, the latter serving as a spreader. This is particularly valuable against plant-lice and leaf-hoppers. It may be used in combinations without the soap with arsenate of lead and a lime-sulfur wash or the bordeaux mixture.

Miscible oils are somewhat widely used as early spring applications for scale insects and certain plant-lice, especially the spruce gall-aphid. The oil preparations spread over a tree rapidly. There is some danger of injuring trees and the directions should be followed carefully in the case of all commercial miscible oils. It is inadvisable to apply oils to sugar maples.

Lime-sulfur washes are among the cheapest and most effective insecticides, as well as exceedingly valuable fungicides. There are a number of good commercial brands on the market. They usually test 30° Baumé and are valuable in proportion to their density; that is, the amount of material in solution. The usual winter application is one to eight and for summer treatment one to thirty or even fifty, much depending on the foliage. These last have been limited largely to fruit-trees.

Various scale insects are controlled very successfully by fumigating with hydrocyanic acid gas, a method largely developed and extensively followed on the Pacific Coast for the protection of fruit-trees. There is no reason why this gas might not be utilized in certain cases for shade or park trees, although the large size of the trees may be a serious obstacle.

Poison bait can frequently be used to advantage in destroying grasshoppers as well as cut-worms and army-worms. A mash composed of twenty-five pounds of bran, one pound of salt, one pound of arsenic, three-fourths of an ounce of amyl acetate (banana oil), two quarts of molasses and ten quarts of water has given excellent results in the West.[1] The bran and poison should be mixed while dry, the sweetening and flavor added to the water, then the poison bran, mixed thoroughly and sown thinly in infested fields. It is desirable to use the technical grade of amyl acetate, since it does not contain impurities that detract to any extent from the pleasing banana-like odor, a fault of the commercial "banana oils," "bronzing liquids" and "amyl acetate derivatives." Six oranges or lemons may be used in the place of the amyl acetate and, if this is done, the fruit should be squeezed into a vessel containing the molasses and water, adding also the

[1] 1922, Parker, J. R., Mont. Agr. Exp. Sta. Bull. 148.

finely chopped or grated remains of the fruit and then the sweetened flavored liquid and the poison bran mixed with it. The above quantities are sufficient for five acres. The salt increases efficiency under certain conditions, though it is not necessary.

Poison baits should not be placed where domestic animals, such as rabbits and chickens, can gain access to them. The best results are obtained if the poison bait is put out shortly before the period of most active feeding. Ordinarily very satisfactory results may be obtained if the bait is distributed in the late morning of bright warm days.

Spraying apparatus.

There have been great developments in spraying apparatus and methods within recent years. An adequate outfit is necessary for rapid and satisfactory results in the treatment of shade trees of cities in particular, although the same general principles apply to the shade trees of villages. Even the best hand equipment means slow, careful work with much climbing if satisfactory results are to be secured.

One of the most important advances in recent years has been the development of a high-power spraying outfit capable of rapidly and thoroughly covering from the ground the foliage of even the largest trees. An effective horse-drawn outfit of this type should have a ten horse power gasoline engine and a triplex pump capable of delivering thirty-five gallons of liquid a minute at a pressure of 225 to 350 pounds. The engine and pump together with a 400-gallon tank can be mounted on a well-built wagon. A more efficient type having higher power and capable of greater working pressure may be mounted on a motor truck. It is necessary to use an inch hose of superior quality and by increasing the pressure at the machine the spray can be conducted through several thousand feet of hose if necessary without greatly reducing the nozzle pressure, which latter should be maintained at about 225 pounds. A solid stream spray delivered through a long nozzle of the Worthley type makes it possible thoroughly to spray even the tallest trees from the ground.

Barrier bands.

Sticky bands of various kinds applied to the trunks of trees are very useful in preventing caterpillars from ascending and may be employed to protect trees near to, but not touching, others which may be badly infested. An effective and suitable banding material has been developed recently in connection with the gipsy moth work. It has the advantage of remaining sticky over a considerable period, it can be applied rapidly and renewed at intervals by combing and it does not penetrate the bark sufficiently to injure trees. It is unsafe to apply bands of tar, grease and some other preparations to the unprotected bark, because such materials may penetrate deeply and kill the trees.

Bands of cotton-batting tied near the middle around the trunk and the upper portion turned down over a string are very serviceable barriers, although not so satisfactory as the sticky bands described above.

These devices afford a considerable protection against the caterpillars of such insects as canker-worms, white-marked tussock moth and gipsy moth.

Destruction of egg masses.

The egg masses of the white-marked tussock moth are conspicuous and easily removed from the flimsy cocoons. Trees cleaned of egg masses in the winter and protected by bands during the caterpillar season can not be injured by this pest. The egg masses of the gipsy moth are easily found and readily destroyed by the application of creosote as noted elsewhere. It is sometimes possible by judicious trimming to remove most of the egg belts of the forest tent-caterpillar and the egg-bearing cases of the bagworm.

Control of borers.

Borer control in shade trees is difficult and is usually dependent to a considerable degree on preventive measures, such as keeping the trees in a vigorous condition and the speedy trimming out of diseased and dead wood. There are some borers, such as the leopard moth, carpenter worm and the hickory bark-beetle, which can be controlled on valuable trees by hand methods, such as the injection of carbon bisulfide into inhabited galleries and the sealing of the orifices with putty or other material. Systematic attention will do much to lessen serious injury. This should be supplemented by careful dressing of wounds in order to promote rapid healing.

Prevention of borer attack by the application of deterrent washes is frequently advised. One of the earlier and better formulas is the following: One pint of crude carbolic acid (one half pint refined, one gallon of soft soap; thin with one gallon of hot water, stir in the acid, allow it to set overnight and then add eight gallons of soft water. Another formula is to add to a saturated solution of washing-soda enough soft soap to make a thick paint; this may be improved by adding one pint of crude carbolic acid and one-half pound of paris green to ten gallons of wash. A third wash may be made by dissolving one gallon of soft soap in six gallons of saturated solution of washing-soda, to which add one pint of carbolic acid and mix thoroughly; enough lime should be slaked in four gallons of water so that when added a thick whitewash will result, then add one-half pound of paris green and mix thoroughly. Young locust borers may be destroyed by spraying the infested parts of the tree with a soluble arsenate, such as one-fourth of a pound of sodium arsenate or arsenite in five gallons of water and added to a quart of miscible oil, making the application in particular to places where there is oozing sap and borings.

The following treatment has given excellent results against flat-headed borers in Michigan, according to Pettit, and is worthy of more extensive trial: Place fifty pounds of common laundry soap (a potash, not a soda soap) over steam pipes and allow it to soften for a few days, then place it in a double boiler with three gallons of water and cook until the temperature reaches 180° F., then stir in two pounds of flour and add twenty-five pounds of flake naphthalene and again bring the temperature to 180° F., at which temperature the naphthalene will have melted, since its melting point is 167° F.; then cool as quickly as may be, since speedy cooling results in smaller naphthalene crystals, stirring the mixture occasionally during the cooling. It may be made up in winter and stored in airtight drums. It should be applied with a brush to the trunk and branches after warming and thinning slightly to the consistency of heavy cream. Applications made at three-week intervals, beginning June 1st, resulted in practical immunity from borers and no injury to the trees.

PART II

Insects Attacking Shade Trees and Ornamentals

There is no sharp division between shade tree insects and those occurring in forests, aside from the fact that the shade tree environment is favorable to certain insects and also permits relatively greater expenditures for the control of injurious insects. It frequently happens that a species somewhat rare in woodlands is a serious menace to trees in cities and villages and occasionally there may be a pronounced shifting in the character of the area attacked, as, for example, in the case of the snow-white linden moth, which, prior to the advent of the English sparrow, was a serious urban pest, whereas at the present time its depredations are confined largely to woodlands. This distinction between shade and forest tree insects is largely a practical one and in most instances it is believed that this division, though by no means entirely satisfactory, will prove convenient.

CHAPTER III

DESTRUCTIVE BORERS AND WOOD GNAWERS

BORERS are among the most important enemies of shade trees, largely because their work is concealed and in certain cases the injury does not become apparent until long after it is accomplished. It is very desirable to keep a close watch for anything suggestive of borer work and to take prompt measures to check such operations if they are discovered.

KEY TO DESTRUCTIVE BORERS AND WOOD GNAWERS

Maples, elms and other trees

Dead limbs projecting above leafy branches or broken or hanging limbs in the midst of otherwise healthy trees, a general borer.
Leopard moth, *Zeuzera pyrina* Linn., p. 32.

Irregular circular galleries some ½ inch in diameter containing large whitish caterpillars and with unsightly scars upon the larger limbs and trunks of various trees.
Carpenter worm, *Prionoxystus robinæ* Peck, p. 33.

Sinuous flattened galleries, mostly in the sapwood, containing flat-headed white grubs, occur in a number of trees.
Flat-headed borer, *Chrysobothris femorata* Fabr., p. 35.

Circular galleries about ¼ inch long containing stout round-headed grubs, occur mostly in thorn, mountain ash and shad.
Round-headed apple borer, *Saperda candida* Fabr., p. 36.

Maples

Dead limbs among leafy branches or transverse ridges and dead areas on branches or trunks of sugar maple.
Sugar maple borer, *Glycobius speciosus* Say, p. 38.

Round holes the size of a medium lead pencil in diseased sugar maple trunks, also in elm and other trees.
Pigeon tremex, *Tremex columba* Linn., p. 40.

Small cleanly cut twigs of sugar maple falling during late summer or hanging with dried leaves in midsummer, also on oak.

Maple and oak twig-pruner, *Hypermallus villosus* Fabr., p. 42.

Deformed and frequently enlarged trunks or branches with ugly warty scars, on both sugar and soft maple.

Callous borer, *Sesia acerni* Clem., p. 43.

Wilting shrubs or small trees easily broken off near the surface of the ground and containing blackened, closely set, nearly horizontal galleries, occurs in a variety of trees and shrubs.

Pitted ambrosia beetle, *Corthylus punctatissimus* Zimm., p. 44.

Elms

Unthrifty American elms and usually dying or dead limbs.

Elm borer, *Saperda tridentata* Oliv., p. 45.

Yellowing foliage and dying tips with characteristic bark-beetle work.

European elm bark-beetle, *Scolytus multistriatus* Marsh, p. 47.

Dying or dead limbs, the inner bark with approximately uniform sinuous galleries.

Elm snout-beetles, *Magdalis barbita* Say and *M. armicollis* Say, p. 48.

Hickory borers

Falling leaves in early summer, dying branches or tops and numerous shot-hole-like exits.

Hickory bark-beetle, *Scolytus quadrispinosus* Say, p. 49.

Large, white, legless grubs in good-sized galleries in the bark and sapwood.

Hickory saperda, *Saperda discoidea* Fabr., p. 51.

Dying or dead hickory limbs inhabited by a black long-snouted beetle.

Hickory snout-beetle, *Magdalis olyra* Herbst., p. 52.

Birch

Dying tops, the smaller limbs with somewhat obscure annular ridges and flattened tortuous galleries in the cambium.

Bronze birch borer, *Agrilus anxius* Gory, p. 52.

Oak and chestnut

Dying tops with a flat-headed grub in tortuous interlacing galleries.

Two-lined chestnut borer, *Agrilus bilineatus* Weber, p. 53.

Locust, black

Irregular ugly scars on trunks or limbs leading to galleries about ¼ inch in diameter.

Locust borer, *Cyllene robiniæ* Forst., p. 54.

Irregular twig swellings 1 to 3 inches long.

Locust twig-borer, *Ecdytolopha insiticiana* Zell., p. 56.

Willow and poplar

Swollen knotty areas on the smaller branches and limbs or shallow burrows overlaid with brown shrunken bark.

Mottled willow borer, *Cryptorhynchus lapathi* Linn., p. 57.

Cottonwood and willow

Cuttings and very young cottonwood trees may be injured by small borers cutting the bark and preventing sap flow or larger borers tunneling the wood and weakening the tree.

Cottonwood borer, *Plectrodera scalator* Fabr., p. 58.

Willow

Sudden wilting of terminal willow shoots in early summer.

Willow-shoot sawfly, *Janus integer* Norton, p. 61.

Poplar

Blackened swollen scars and large galleries with coarse excelsior-like borings.

Poplar borer, *Saperda calcarata* Say, p. 59.

Linden

Large irregular galleries at the base of the trunk inhabited by white legless borers.

Linden borer, *Saperda vastita* Say, p. 62.

Ash and lilac

Whitish or yellowish legless grubs in trunks and stems.

Lilac borer, *Podosesia syringæ* Harr., p. 63.

Cratægus or thorn

Oval swellings about 1 inch long with four to five longitudinal scars on small limbs and stems.

Thorn limb-borer, *Saperda fayi* Bland., p. 64.

Rose

Elongate stem swellings, sometimes in several places or following spiral or longitudinal lines.

Rose stem-girdler, *Agrilus viridis* Linn., p. 64.

Rhododendron

Wilting or yellow leaves and borings in branches or stem.

Rhododendron clear wing, *Sesia rhododendri* Beutm., p. 65.

(See also Pitted ambrosia beetle, p. 44.)

Gnawing bark from various trees and shrubs.

European hornet, *Vespa crabro* Linn., p. 66.

Boring in dead wood

White, wingless, ant-like creatures in decaying timbers and dead stumps.

White ants, *Reticulitermes flavipes* Kollar, p. 67.

Burrows about ½ inch in diameter in telegraph poles, door posts, and the like.

Large carpenter bee, *Xylocopa virginica* Drury, p. 69.

Leopard Moth

Zeuzera pyrina Linn.

Dead limbs projecting above leafy branches or broken and hanging limbs in the midst of otherwise healthy trees are the most conspicuous signs of this borer's presence.

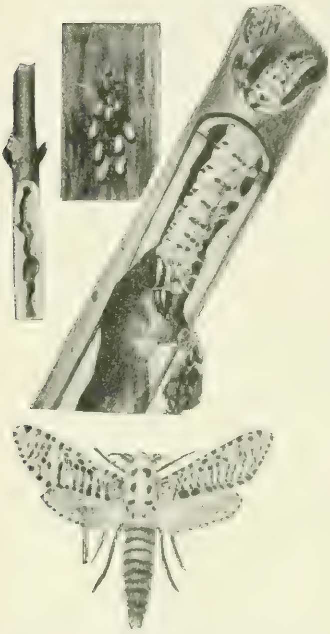

Fig. 1.—Leopard moth, adult, work in small twig, borings hanging from the bark and nearly full-grown larva, reduced.

The leopard moth (Fig. 1) attacks a very large number of trees and shrubs. It shows a marked preference for elms and maples, particularly soft maples, though horse-chestnut, beech, birch, dogwood, hickory, oak and walnut may be severely injured. The insect is well established along the coast of the northeastern United States. The white, blue and black-spotted moths have a wing spread from nearly 2 to about 3 inches, the larger being females. Flight occurs during June through to September, the moths being most numerous early in July. The eggs are deposited in crevices in the bark, on branches as well as on the trunk. The young caterpillars frequently enter the twigs at the base of a bud, often causing wilting, and as they increase in size desert the smaller branches and make large irregular galleries in the larger limbs or trunks. These later workings cause the somewhat characteristic breaking of limbs about two inches in diameter so evident on badly infested trees. The borer is a pinkish or white caterpillar with numerous, well-defined, darker spots or tubercles on its body, a brown head, and thoracic and anal shields of nearly the same size and color near the extremities of the body. The second summer is the period of greatest injury. Full-grown caterpillars are over three inches long. They winter in the burrows and transformation to the moth occurs the following season, approximately two years after the eggs were laid.

It is entirely possible to check this pest effectively by systematically cutting infested twigs in late summer and early fall and burning them at once, otherwise the borers may escape from the twigs. This can also be followed to a limited extent with larger branches, though better results are likely to follow the destruction of the larger caterpillars in their burrows with a bent wire or by the injection of bisulfide of carbon, with the aid of a long-spouted oil-can. Inhabited burrows are readily detected by the fresh borings or frass. It is frequently possible to destroy some of the rather sluggish females before eggs are deposited, particularly on small trees. Collecting at lights or the use of a moth trap consisting of a pan containing kerosene and water hung under lights are both useful supplements to the foregoing measures.

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1911, Britton, W. E., and Cromie, G. A., Conn. Agr. Exp. Sta. Bull. 169, pp. 1–24.

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Carpenter Worm

Prionoxystus robiniæ Peck

The large reddish-white caterpillars boring large holes in the bigger limbs and trunks of different kinds of oak, maple and locust usually belong to this species (Fig. 2).

The insect is a widely distributed native species only occasionally sufficiently abundant to endanger the life of the tree, although it rather frequently produces large unsightly scars. It appears to be primarily wound-infesting and continues year after year to increase the size of an infested area on the

Fig. 2.—Carpenter worm, moth, eggs, pupa, borer and work, slightly reduced.

Fig. 3.—Flat-headed borer, work in apple, reduced.

trunk or large limb. Most of the tunneling is through the wood and consequently the vital cambium escapes injury to a considerable extent. It is not uncommon for this borer fairly to riddle portions of a trunk fifteen inches or more in diameter.

The moths are in flight in New York state during the greater part of June and early in July and on the Pacific Coast during

May and June. The eggs are apparently deposited by preference in the vicinity of some wound or scar and after the insect has once obtained an entrance this seems to be a favorite point of attack. The young larvæ feed first upon the soft inner bark, later penetrating the harder sapwood and finally the solid hard wood, the galleries running mostly in a longitudinal direction. The life cycle of this species is believed to extend over three years. The full-grown caterpillar is about 2½ inches long. The head is brown and there are well-developed, dark brown, thoracic and anal shields near the extremities of the body. The adult is a magnificent grayish moth having a wing spread of about 3 inches. The fore part of the hind-wings is nearly black, the most of the posterior portion with a large reddish blotch.

The moth's habit of depositing eggs in crevices, particularly about injuries caused by earlier attacks, suggests keeping the trunks of trees as smooth as possible. Rough wounded places should be carefully dressed and in the case of more serious injury, treatment with carbon bisulfide and the sealing of the galleries with cement or other material is advisable. Inclosing the infested portion of the trunk with a temporary screen cage and the daily destruction of the borers during the flight period has been recommended by Burke for highly valued trees. This is probably the most economical and effective method of controlling the pest.

References

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 79–84.
1921, Burke, H. E., Econ. Ent. Journ. 14:369–372.

Flat-Headed Borer

Chrysobothris femorata Fabr.

These rather slender white grubs, noteworthy because of the greatly enlarged anterior portion, make wavy flattened galleries in the wood of various trees (Fig. 3).

The parent insect is an inconspicuous, metallic, grayish, flattened beetle about ½ to ⅝ of an inch long. It is in flight from the latter part of May into September and frequently may be seen on the sunny side of a tree. The eggs are deposited on the bark, probably in crevices, the young grubs making their way into the tree and during the early stages feeding upon the sapwood. Increase in size is accompanied by penetration deeper into the tree, the winter being passed at some depth within the wood. The borers, nearly 1 inch long when full grown, come toward the surface in the spring, construct a pupal cell and the beetles emerge as indicated. This species is known to attack a considerable series of trees.

Trees in an unthrifty condition are more likely to be attacked. One of the most promising control measures is to cut and burn all sickly or dying wood, thus reducing favorable breeding conditions to a minimum. Pettit has obtained excellent control of this pest by painting limbs and branches with a naphthalene-soap compound. (See page 26.)

References

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 86–87.
1914, Slingerland, M. V., and Crosby, C. R., Manual of Fruit Insects, pp. 194–198.

Round-Headed Apple Borer

Saperda candida Fabr.

A stout, white, legless grub over an inch long infests thorn-apple, mountain ash and shad-bush as well as fruit-trees, working mostly at the base of the trunk (Fig. 4), frequently killing trees.

This insect is better known as an apple-tree pest, though it attacks a number of other trees and is particularly likely to injure valued ornamentals. The parent beetle is about ¾ inch long and may be recognized easily by its brownish color with two broad white bands joined at the front and extending to the tip of the wing-covers. It is abroad from May to September and most of the eggs are presumably deposited in small slits in the bark in June. The young grubs work in the inner bark and sapwood, tunneling the tree at or close to the surface of the ground. An inhabited burrow is easily recognized by the fresh borings hanging therefrom. It is generally believed that three years are necessary for the completion of the life cycle.

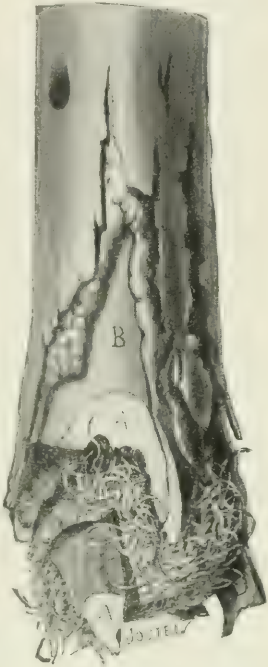

FIG. 4.—Round-headed borer, work in apple, reduced.

There is no more effective method of preventing injury by this insect than the repeated examination of trees for signs of borings and the destruction of the pests before they are large enough to cause serious injury. A careful inspection in early spring and fall should be sufficient. It is advisable to keep the ground around the base of the tree clear of weeds or rank growths of grass. Some protection can be secured by the use of bands of old newspapers or wire mosquito netting, provided they are applied so well that the beetles can not get behind them or work up from beneath. Ordinarily they are not used extensively.

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Sugar Maple Borer

Glycobius speciosus Say

Dead limbs among leafy branches or transverse ridges and dead areas on branches or trunks of sugar maples are signs of the work of the large fleshy grub of this insect (Figs. 5, 6).

Fig. 5. — Sugar maple borer, showing egg-slit, young and full-grown borers, beetle, exit hole and work, reduced.

The sugar maple borer is a very common insidious enemy of sugar maples in the northeastern United States, and mutilates and destroys many trees. It is unusual to find a group of sugar maples in New York state uninfested by this insect and in not a few instances a goodly proportion of the trees have been seriously damaged. The work progresses so slowly that ordinarily it attracts no attention and in many cases may be attributed to other causes.

The powerful, whitish, legless grubs, some 2 inches long when full grown, confine their operations largely to the inner bark and sapwood, running burrows several feet long and usually obliquely transverse for a distance, thus very effectively girdling a portion of a trunk or large limb. This injury is followed by the development of new tissue in an effort on the part of the tree to heal the wound and the characteristic oblique ridge which may later break away and expose to the elements a constantly increasing area of dead wood. Sometimes there are a series of interlacing burrows on one side of the trunk and a large, dead, decaying area soon develops.

The large, black, brilliantly yellow-marked beetles about an inch long occur on the trunks of maples from the latter part of June till into August, depositing eggs in slit-like cavities in the bark. These latter are indicated by an irregular discoloration caused in part by sap flowing from the wound and partly from expelled frass or excrement, the latter often hanging in small masses from the point of entrance. The young borers winter in a rather shallow excavation in the sapwood, and the following season, the period of maximum injury, cut galleries in the inner bark and sapwood about half an inch in width and one-third of an inch in depth, running in almost any direction, though usually longitudinally or obliquely upward and partly around the tree.

Fig. 6.—Sugar maple borer, work on trunk, greatly reduced.

The most effective control measure, practicable only on valued shade and lawn trees, is to examine the trunk and the base of the larger limbs in particular in September for the early work of young grubs and the cutting out and destroying them before material injury is caused. It is also feasible, in some instances, to capture the beetles in June and July, preferably before they have had an opportunity to deposit eggs.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 51–56.

Pigeon Tremex

Tremex columba Linn.

Round holes the size of a medium lead pencil in the diseased trunks of maples, elms and other trees are characteristic of the work of this insect (Figs. 7, 8).

Fig. 7.—Pigeon tremex.

The pigeon tremex is a black and yellow marked, magnificent, four-winged fly about 2 inches long, a wing spread of 2½ inches and a rather prominent horn at the posterior extremity of the abdomen. This structural peculiarity has led to the bestowal of the common name, horn-tails, on these and related insects. The females are frequently found on trees with the short stout ovipositor bent at right angles to the body and driven to its full length into the tree. Occasionally the remains of a number of these wasp-like insects may be found securely attached to trees by their ovipositors, the insects having been unable to withdraw them. Observations show that the grubs confine their operations to the fungus-affected or dying trees and consequently cause little or no injury.

The pigeon tremex is occasionally parasitized by the lunate long-sting, *Megarhyssa lunator* Fabr., a slender, brown and yellow wasp-like insect about 1½ inches long and noteworthy because of the delicate tail or ovipositor some 3 inches long,

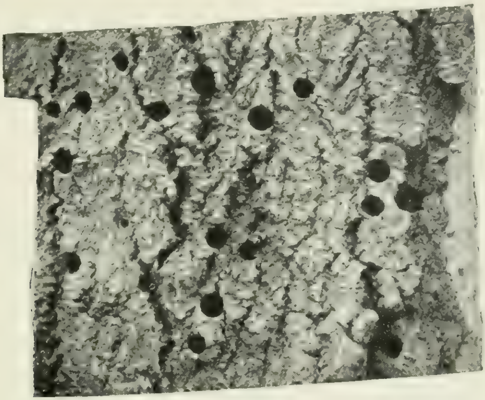

Fig. 8.—Exit holes of pigeon tremex, larger, and lunate long-sting, smaller, greatly reduced.

whence its common name of long-sting. This insect is frequently seen with its long ovipositor arched over the back and the membrane of the terminal segments of the abdomen distended as it forces its slender tool into the wood in an effort to place eggs in the vicinity of a borer, usually in a borer gallery. The lunate long-sting is also a parasite of the sugar maple borer and is more serviceable on this account than because of its destroying larvæ of the pigeon tremex. There is also a larger very similar parasite to the lunate long-sting known as the black long-sting, *Megarhyssa atrata* Fabr., with similar habits.

Control or remedial measures are not recommended for either the pigeon tremex or the long-stings, since the first causes negligible injury and the latter are beneficial rather than injurious.

Fig. 9. — Maple and oak twig-pruner, work on small branches, borer and pupa in galleries, reduced.

Reference

1915, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 61–63.

Maple and Oak Twig-Pruner

Hypermallus villosus Fabr.

Small cleanly cut twigs of oak and maple falling during late summer or hanging with dried leaves from midsummer on are signs of this insect's work (Fig. 9).

This beetle is a true twig-pruner and confines its operations to branches or small limbs with a diameter of about an inch or less. It seems to be particularly abundant and injurious in the vicinity of New York City. The eggs are deposited in July on the smaller twigs, the young grubs feeding for a time under the bark and later boring along the center of the branches, making a more or less oval channel. In late summer the borer eats away a large portion of the woody fiber, plugs the end of its burrow with castings and waits for a high wind to break off the nearly severed branch. Late in the fall or in early spring the grub changes to a pupa and a rather slender grayish-brown beetle about 5/8 of an inch long emerges and continues abroad till September. The life cycle is probably completed in one year. The insect has been recorded as attacking apple, pear, plum, peach, grape, quince, orange, osage orange, hickory, chestnut, locust, sassafras and sumac.

Since the insect winters within the fallen twigs, a very fair degree of local control can be secured by collecting and burning these twigs during the winter or early spring.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 59–61.

Callous Borer

Sesia acerni Clem.

Deformed and frequently enlarged trunks or branches of maples or ugly scars here and there on the trunk showing brownish powdery borings near the surface and frequently small circular orifices about 1/8 inch in diameter are usually the work of this insect (Fig. 10).

Fig. 10.—Callous borer, work, pupal skin, exit holes, pupa and borers, greatly reduced.

This small borer displays a marked partiality for the soft tissues around healing wounds on maples and is sometimes very abundant and at least somewhat injurious to soft maples. The moths are in flight from the latter part of May to the middle of June. The eggs are deposited on roughened places in the bark. They soon hatch and the young caterpillars tunnel the inner bark and sapwood. The full-grown caterpillars are whitish, brown-headed and about 1/2 inch long.

The most promising control measure consists in taking advantage of the moths' marked inclination to deposit eggs on rough bark. The trunks of trees should, therefore, be kept as smooth as possible and wounds carefully covered with grafting wax, paint or other protective substances. An infested area should be carefully examined, the borers dug out and destroyed and the surface dressed as in the case of any other wound.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 56–58.

Pitted Ambrosia Beetle

Corthylus punctatissimus Zimm.

Wilting or dead shrubs or small trees easily broken off near the surface of the ground and containing series of blackened, closely set, nearly horizontal galleries $\frac{1}{16}$ inch in diameter may be the work of this insect.

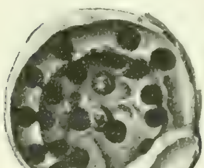

Fig. 11.—Pitted ambrosia beetle, section of work in rhododendron stem.

This insidious borer is quite local in its habit and is occasionally very injurious to ornamentals. The beetles enter the side of the stem at or just below the surface of the ground or protecting mulch through a circular hole about $\frac{1}{16}$ inch in diameter. This opens into a more or less regular series of circular, closely placed, horizontal galleries which may be so numerous as to leave only a very thin shelter of bark with a little of the outer sapwood and almost no direct longitudinal wood fibers between the outer and inner horizontal galleries. From each of these latter there are series of vertical brood chambers, each about $\frac{1}{8}$ inch long and usually one or more nearly vertical galleries which lead to lower or upper series of workings, not infrequently both. The work of this borer is confined to parts within three inches above the ground and apparently does not extend to the roots, though the lowest galleries may approach closely to the ground. The dark brown or black, cylindrical, rather stout beetles about $\frac{1}{8}$ inch long are known to attack sugar maple, sassafras, dogwood, water-beech (Carpinus), ironwood (Ostyra), hazel, huckleberry and rhododendron (Fig. 11). The species is widely distributed throughout the eastern United States.

Seriously infested shrubs and small trees can not be saved. The wilting infested stems should be cut and burned, care being taken to prevent breaking the shoots at the point of injury and thus allowing a number of the beetles to fall out of the galleries and invade other plants. Systematic cutting out of weakened specimens is advisable in the case of ornamentals and if followed up should prevent serious injury. Injury appears to be confined largely to shaded localities where there is an abundance of mulch, sunny grassy areas being practically free from the pest. This latter is suggestive so far as future plantings are concerned.

References

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 65–67.
1915, Felt, E. P., N. Y. State Mus. Bull. 175, pp. 36–39.

Elm Borer

Saperda tridentata Oliv.

An unthrifty condition indicated by dying or dead limbs and diseased or dying areas of bark on the trunk of American elms are the most frequent signs of injury by this pest (Fig. 12).

This borer is sometimes as injurious to the white elm as the sugar maple borer is to sugar maples and in places in which the elm pest has become well established, even greater damage may result from its attack. The first signs of infestation are usually seen in the lighter thinner foliage followed by a limb dying here and there. Soon dark sawdust collects in the crevices of the bark, an indication of boring, and after the attack has progressed for a time, large portions of the bark can be pulled easily from the tree, and it is then seen that the inner bark and outer sapwood have been entirely destroyed. The cause of this injury is a modest, gray, red-marked, black-spotted beetle about 1/2 inch long. The life cycle is probably completed in one year, though there is a possibility that two may be required. The change to pupæ occurs about the middle of May and the beetles begin to appear the latter part of that month and continue to emerge for some time, depositing eggs in the bark. This borer appears to infest the white elm almost exclusively, though it has been recorded from the slippery elm.

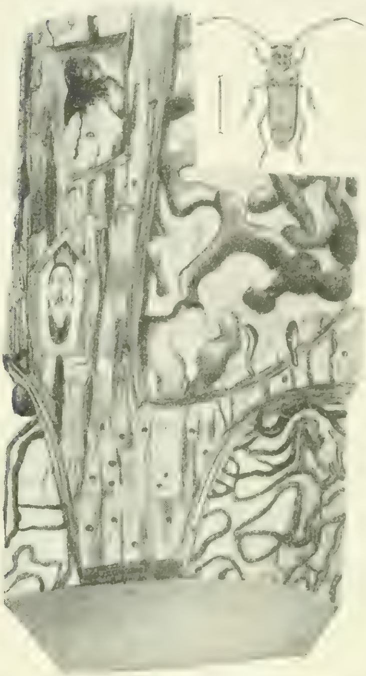

Fig. 12.—Elm borer, grub and galleries, pupa, adult (enlarged); smaller borings work of elm snout-beetles, reduced.

Badly infested trees should be cut and burned before the beetles have had an opportunity to emerge. The systematic removal and destruction of infested trees or parts of trees is probably the most satisfactory method of handling infestations of this character.

REFERENCE

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 67–71.

EUROPEAN ELM BARK-BEETLE

Scolytus multistriatus Marsh

Yellowing foliage and dying tips of elm are the first signs of borer injury in the upper part of the tree. In the case of this insect there are found under the bark series of connected galleries inhabited by legless white maggots, or black and red bark-beetles about ⅛ inch long may be found in oval cells in the bark and outer sapwood.

This bark-borer is another addition to the already formidable list of shade tree pests recently established in this country. It probably occurred in the vicinity of Boston prior to 1905 and in 1911 it was found in a number of towns in the vicinity of Boston, Massachusetts.

The first signs of attack are collections of reddish bark sawdust excavated by the beetles as they enter the tree. These are found on the rough portions of the bark below the point of entrance. Numerous circular exit holes about ⅛ inch in diameter indicate that the insects have left the tree. This insect breeds by preference in weak or sickly elms, though it has been recorded in England from poplar, cherry, pear, plum and oak. The female excavates a long vertical gallery between the inner bark and sapwood, depositing minute whitish eggs in chambers on either side. The longest galleries sometimes contain as many as 140 eggs, usually there are not more than 80. Oviposition extends over a period of several weeks, consequently a gallery may contain both eggs and partly developed larvæ. The first brood in eastern New England deposits eggs the last of May and in June and the second the last of August and early in September. The grubs of the second brood winter in the inner bark and complete their development during the first warm days of spring. The pupal cells are constructed in the outer bark just under the surface.

The beetles are stout, cylindric, $\frac{1}{10}$ to $\frac{1}{8}$ inch long. The thorax is shiny black and somewhat longer than broad. The wing-covers are pitchy red and the antennæ and legs light brown. The male is smaller than the female, the latter with prominent toothed projections on the lateral edges of the third and fourth abdominal segments. The full-grown grub is about $\frac{1}{8}$ inch long, whitish, wrinkled, legless and usually rather strongly curved, the thoracic segments distinctly larger.

Keeping elms in a healthy vigorous condition tends to prevent attack. The trees should be examined frequently and weak or dying branches cut and burned before the borers begin to issue.

Reference

1911, Chapman, J. W., The Leopard Moth and other Insects Injurious to Shade Trees in the Vicinity of Boston, pp. 30–40.

Elm Snout-Beetles

Magdalis barbita Say and *M. armicollis* Say

Dying or dead limbs with the inner bark infested by short, white, curved, legless grubs in approximately uniform galleries or with the outer bark showing numerous small circular exit holes are usually caused by the work of one or both of these insects.

The adults emerge from infested wood the latter part of May or early in June and feed to some extent upon the foliage. The beetles are only about $\frac{1}{4}$ inch long, the first-named species being jet black and the second, apparently the rarer, reddish. The life cycle is probably completed in one year. The burrows of the grubs are $1\frac{1}{2}$ inches long, somewhat uniform in size, sinuous, running generally with the grain and are confined very largely to the inner layers of the bark (Fig. 12, smaller workings).

Systematic cutting and burning of infested wood as recommended for the elm borer is the most effective control measure, though some protection may be secured by spraying the foliage toward the last of May with an arsenical poison.

REFERENCE

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 73–75.

HICKORY BARK-BEETLE

Scolytus quadrispinosus Say

Signs of infestation by this insect are falling leaves in early summer, dying branches, tops of trees or entire trees, followed by numerous shot-hole-like exits made by small brown or black beetles.

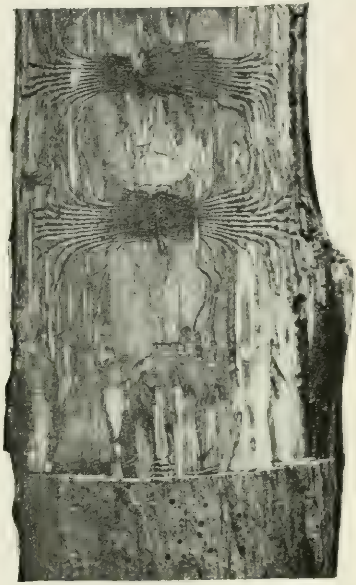

FIG. 13. — Hickory bark-beetle, exit holes and galleries, much reduced.

The hickory bark-beetle (Figs. 13, 14) is the most deadly enemy of this valuable tree in the northeastern United States. At irregular intervals it becomes extremely abundant and kills thousands of hickories, including some of the largest and noblest trees. This insect occurs over the entire eastern United States in all varieties of hickory.

The dark brown or black beetles about $\frac{1}{5}$ inch long appear from the last of June to the last of July, persist to the middle of August and bore into young twigs, terminal buds and green nuts and frequently cause the wilting and dropping of leaves and the death of twigs. The beetles attack the bark of the trunk and larger branches in July, each female making a vertical gallery an inch or more in length, on the sides of which twenty to forty or more eggs are deposited in small notches. The young grubs work at first at approximately right angles to the wood fibers, thus very effectively girdling portions of the tree. The older grubs, especially those near each end of the parental gallery, usually turn away from the central portion and as a result there is a very characteristic gallery. Frequently hundreds of beetles enter the trunk in somewhat regular rows one above the other on all sides and consequently a badly infested tree is speedily girdled and killed.

Fig. 14. — Hickory bark-beetle, early work and galleries of young borers, reduced.

Wilting leaves in early summer and dead twigs in midsummer are the first signs of infestation, although in most cases the insect escapes notice until the top begins to die or the entire tree is practically killed. Invasion of the trunk is indicated by fine particles of brownish and white sawdust in the crevices of the bark. Trees which have been entered by thousands of beetles are beyond hope, practically speaking, and should be cut and the bark at least burned before another spring in order to prevent the beetles escaping and attacking other trees. There are grounds for believing that hickories not suffering from drought or other adverse conditions are more likely to resist infestation, consequently abundant nourishment and plenty of moisture are excellent general preventives. The early feeding habits of the beetles suggest thorough spraying of prized lawn trees about the middle of May, using arsenate of lead at the rate of six to eight pounds of paste to fifty gallons of water, taking special pains to cover the twigs and base of the leaf-stalks with the insecticide. Beetles can be destroyed just after they have entered the tree by injecting gasoline, carbon bisulfide or some similar material in the burrows. This is a costly, laborious operation and advisable only in special cases. In woodland areas cutting and destroying infested trees or parts of trees as directed above is practically the only hope and if over 75 per cent of the insects are killed in this manner, there is little danger from the survivors.

References

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 275–279.
1918, Houser, J. S., Ohio Agr. Exp. Sta. Bull. 332, pp. 320–321.

Hickory Saperda

Saperda discoidea Fabr.

The large, white, legless grub of this insect makes good-sized galleries in the bark and sapwood of hickory.

Ordinarily this species does not cause much damage, although it is a rather common borer in hickory. It frequently follows the work of the hickory bark-beetle and is occasionally so abundant that a piece of bark six inches square may contain a dozen or more borers. It is remarkable in that the sexes are so unlike that one unacquainted with the fact would certainly consider the two as belonging to distinct species. The beetles are abroad the latter part of June and in July. The borers work partly in the bark and partly in the wood. The female is about 3/4 inch long, has a yellowish thorax and yellowish markings on the brownish wing-covers, while the male is about 1/2 inch long and has a black head and thorax and uniform gray wing-covers. A closely related species, the red-edged Saperda, *Saperda lateralis* Fabr., also attacks hickory, it being especially prevalent near the roots and in the base of sprouts on recently cleared land.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 269–270.

Hickory Snout-Beetle

Magdalis olyra Herbst.

Dying or dead hickory limbs are rather commonly inhabited by a black long-snouted beetle about $\frac{3}{16}$ inch long.

This species appears to confine its attack very largely to diseased and dying trees and is sometimes found in such large numbers that the inner bark and outer sapwood may be almost riddled by the many irregular confused galleries. It appears to prefer limbs from 4 to 6 inches in diameter, although it has also been reared from small twigs. It is ordinarily not considered as an important enemy of hickory.

Fig. 15.—Bronze birch borer, adult and grub, enlarged.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 274–275.

Bronze Birch Borer

Agrilus anxius Gory

Dying tops of white birch, the smaller limbs with somewhat obscure annular ridges and flattened tortuous galleries beneath the bark, are characteristic of this pernicious borer (Figs. 15, 16).

A very considerable proportion of the ornamental white birch in parks and on lawns in the northeastern United States and in some western cities and villages have been killed by the work of the slender, white, flat-headed grub about $\frac{3}{4}$ inch long, with peculiar brownish forks at the posterior extremity, found in tortuous shallow galleries in the inner bark and outer sapwood of various birches. The rather slender brownish beetles, only $\frac{3}{10}$ to $\frac{1}{2}$ inch long, appear usually in June, feed for a time and then deposit eggs in tiny slits in the bark, the grubs working as indicated above and the parent insects issuing the following spring.

Dying trees or parts of trees should be cut and burned during the winter or early spring following attack; otherwise the contained insects may escape and attack other birches. All too frequently this cutting and burning is delayed until the beetles have escaped, which latter is evidenced by numerous irregularly oval holes, after which such operations have little control value. The beetles feed to some extent upon birch and elm foliage, consequently spraying birch and adjacent trees early in June with a poison would presumably destroy many of the insects before they could deposit eggs in the trees.

Fig. 16.—Bronze birch borer, annular swellings in limb.

References

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 284–287.
1918, Houser, J. S., Ohio Agr. Exp. Sta. Bull. 332, pp. 326–327.

Two-Lined Chestnut Borer

Agrilus bilineatus Weber

Dying tops or limbs of oak and chestnut may follow the work of a white flat-headed grub found in tortuous interlacing burrows under the bark.

This beetle (Fig. 17), like the related destructive bronze birch borer, is locally abundant in the northeastern United States at least and not infrequently causes the death of individual trees or groups of trees, much depending on local conditions. The parent beetle is only ⅜ inch long, rather slender, blackish and sparsely clothed with a light golden-yellow pubescence. The beetles are abroad the latter part of May or in June, the eggs are deposited in the tree and the grubs work in the inner bark and outer sapwood. The galleries are flattened, very sinuous, usually interlacing and inhabited by a slender, whitish, flat-headed grub about ½ inch long and peculiar in the possession of a pair of brownish forks at the posterior extremity. The final transformations occur in the wood, the beetles appearing the following spring.

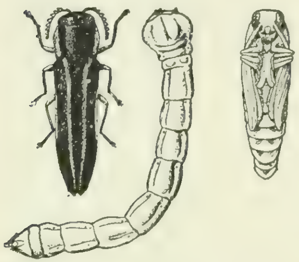

Fig. 17.—Two-lined chestnut borer, adult, grub and pupa, enlarged.

Badly infested trees or parts should be cut and the outer bark at least burned in the winter or early spring following infestation. Numerous obliquely oval exit holes indicate that most of the beetles have escaped. The systematic trimming and burning of dying or dead wood will do much to reduce the danger of infestation. The beetles probably feed to some extent upon the foliage, consequently some benefit may be expected by spraying with a poison late in May or early in June.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 280–283.

Locust Borer

Cyllene robiniæ Forst.

The irregular ugly scars on locust trunks and leading into galleries about ¼ inch in diameter are the work of the locust borer.

This borer (Fig. 18) is very destructive to black locust in different parts of the United States and in some sections makes it very difficult to grow locusts, badly disfiguring them and occasionally destroying considerable plantings of trees 2 to 5 inches in diameter.

The black golden-marked beetles about ¾ inch long appear in late summer and during September in particular may be seen in large numbers feeding on the blossoms of goldenrod. The eggs are commonly deposited in small crevices on the bark, and the young grubs bore for the remainder of the season and hibernate in the outer bark, penetrating more deeply the following spring and excavating the series of characteristic curved galleries so frequently found in this tree. The first evidence of attack in the spring is brownish sawdust and wet spots. Later the work of the borers is indicated by wet yellowish sawdust and gummy exudations. The most serious injury is caused by the boring in the inner bark and outer sapwood. Growth is rapid and transformation to the beetle occurs about midsummer or a little later, adults appearing in August and September.

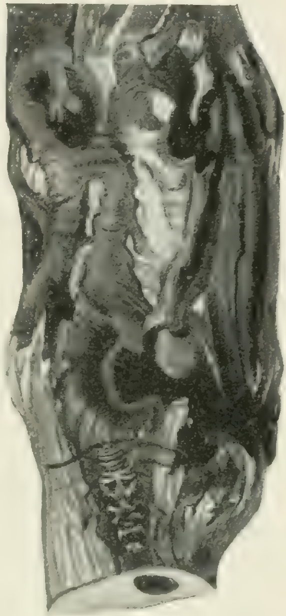

Fig. 18.—Locust borer, work and adult, reduced.

Craighead states that locusts planted in thick stands or grown in the shade of other trees for the first ten or fifteen years are relatively free from borer injury. There is a possibility of saving very badly injured locust plantings by cutting and burning all the badly affected trees and relying on the growth of sprouts. Systematic cutting and burning of badly infested trees over considerable areas has been recommended. Young borers can be killed readily on the more valuable shade trees by spraying with an arsenical poison when the new growth begins in the spring, giving special attention to places where borers are working, the latter indicated by oozing sap and borings. A soluble arsenate, such as one-quarter pound of sodium arsenate or arsenite in five gallons of water added to a quart of miscible oil, has proved most effective.

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1906, Hopkins, A. D., U. S. Dept. Agr. Bur. Ent. Bull. 58, Parts I, III.
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1918, Houser, J. S., Ohio Agr. Exp. Sta. Bull. 332, pp. 316–317.
1919, Craighead, F. C., U. S. Dept. Agr. Bull. 787, pp. 1–12.

Locust Twig-Borer

Ecdytolopha insiticiana Zell.

The work of this insect is indicated by irregular twig swellings 1 to 3 inches long, containing a whitish or pale yellowish caterpillar about ½ inch long.

The locust twig-borer is an important enemy of nursery trees in Kentucky. The twig swelling is produced by the gnawing of the interior of the branch. There appear to be several generations in Kentucky, though Houser states that in Ohio the borers drop to the ground by mid-autumn and pupate among the leaves, the adults emerging late in the season. The most effective control measure is to cut and burn the infested shoots.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, p. 478.
1915, Garman, H., 2nd Bien. Rept. State Forester, Ky., pp. 22–23.
1918, Houser, J. S., Ohio Agr. Exp. Sta. Bull. 332, pp. 317–318.

Mottled Willow Borer

Cryptorhynchus lapathi Linn.

Willow and poplar branches and trunks are frequently seriously injured by small white grubs which transform in midsummer to dark colored snout-beetles about 1/4 inch long.

The mottled willow borer (Fig. 19) is another introduced enemy of trees. It was found in New Jersey in 1887 and has since become rather generally distributed in the northeastern United States. The work of this borer is most frequently indicated by swollen knotty areas on the smaller limbs and branches, the shallow burrows frequently being overlaid with brown shrunken bark. The full-grown borer or grub is about 1/2 inch long, fleshy, white and legless. The beetle or curculio is from 1/3 to 3/8 inch in length. The body is dull black with little spots or tufts of jet black scales or hairs on the thorax and the wing-covers, the posterior third of the latter, the sides of the thorax, the base of the anterior femora and portions of the middle and posterior femora being pinkish-white. The beetles appear in midsummer and deposit their eggs in small punctures in the bark. The burrows of the young grubs may be found around buds, at the base of limbs and frequently partly girdle the stem. The nearly full-grown borers make galleries about 1/8 inch in diameter and work in about the same manner as the smaller grubs. When full grown they penetrate to the center of the small stems, frequently a distance of 3 or 4 inches, pupate

Fig. 19. — Mottled willow borer, external signs and section of galleries, reduced.

at the extremity, the adults issuing during July, August and September, indicating a considerable divergence in the period of development.

Badly infested trees or parts of trees should be cut and burned in winter in order to destroy the contained borers. It is possible to destroy many of the hibernating grubs by applying a carbolineum emulsion in December or April, the latter probably being safer. Experiments indicate a considerable degree of benefit by spraying with poison the last two weeks in July.

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Cottonwood Borer

Plectrodera scalator Fabr.

Cottonwood and willow trees may be injured by small borers cutting the bark and preventing sap flow or by larger borers tunneling the wood and weakening the tree.

The cottonwood beetle is 1¼ to 1½ inches long, stout, black, with irregular stripes and patches of cream-colored scales and with slender antennæ distinctly longer than the body. The eggs are deposited in the trunks of cottonwoods and willows at or a little below the surface of the ground, the young borers working first in the cambium layer near the surface of the ground to several inches below. Two years are required for the completion of the life cycle, adults being abroad during most of July and into August. Serious injuries to both cottonwoods and willows by this insect have been reported from the Middle West.

Since the eggs are deposited only on the trunks of the trees near the surface of the ground, infestation may be prevented by screening the bases of the trees during July and August. Young larvæ may be cut out early in September.

REFERENCE

1916, Milliken, F. B., U. S. Dept. Agr. Bull. 424, pp. 1–7.

POPLAR BORER

Saperda calcarata Say

The large, blackened, swollen scars on the trunks and limbs of poplars and the coarse excelsior-like borings are usually caused by this insect (Fig. 20).

Fig. 20.—Poplar borer, adult, pupa, larva and work, reduced.

The poplar borer is locally abundant and in the East occasionally quite destructive to individual trees or groups of trees. The work of this pest is most noteworthy in park and shade trees, though it also is injurious in the forest. It appears to be generally destructive to cottonwoods and poplars in the western states.

The parent insect is a large, grayish, yellowish-marked, stout beetle about $1\frac{1}{4}$ inches long. It may be found on the trunks and branches from July to September. The eggs are deposited in slits in the bark and the young borers work in the inner bark and outer sapwood and before the approach of cold weather penetrate to a greater depth. The burrows of the second year are very largely at some depth in the wood and during this stage trunks or limbs may be honeycombed with very large irregular galleries. The nearly full-grown borers not infrequently excavate large shallow galleries in the sapwood and inner bark and appear to subsist to a considerable extent on the sap collecting in such cavities. They frequently produce quantities of coarse excelsior-like borings which collect at the base of badly infested trees. Transformation to the adult occurs within the trees, the pupal stage lasting about three or four days. Three years are probably required to complete the life cycle. This insect attacks practically all poplars and ranges from Canada south to Texas and entirely across the United States.

Painting egg scars in October with carbolineum or creosote kills the young borers. Digging out the older ones with a wire or destroying them by injecting carbon bisulfide are the most practical control measures. Badly infested trees should be cut and burned or dried quickly.

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Willow-Shoot Sawfly

Janus integer Norton

Sudden wilting of the terminal shoots may be caused by this insect girdling the twigs after the eggs are deposited.

The wasp-like insect (Fig. 21) about ½ inch long not only attacks willows but is well known as an enemy of currants. It occasionally becomes so abundant as severely to injure an entire planting of basket willows. It has been reported from

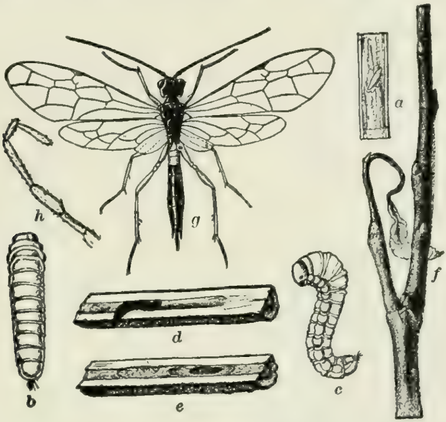

Fig. 21.—Willow-shoot sawfly, egg, pupa, larva, galleries, injured shoot and adult, reduced.

Kentucky, Indiana and Ohio. The female deposits her eggs in shoots in early spring and then girdles the stem below in order to prevent its further growth and thus protect the egg. The borers traverse the pith for a distance of two feet or more, completing their growth in early November. The transformation to the adult occurs within the shoot. Cutting and burning the wilting shoots, although somewhat costly, effectively controls this insect.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 302–303.

Linden Borer

Saperda vestita Say

Large irregular galleries at the base of the tree containing white legless borers are most probably the work of this insect (Fig. 22).

Fig. 22. — Linden borer, work, adult and grub, reduced.

The linden borer is a rather common pest and is occasionally quite injurious, attacking young trees in the nursery as well as older specimens. The beetles appear toward the end of the summer and feed on the bark, leaf-stems, the underside of the larger veins and often kill the tips of branches, by injuring the green bark. The eggs are deposited in slight incisions on the trunk and branches and the grubs mine the bark for a distance of six to eight inches and often penetrate the wood to a considerable extent. This borer confines its operations very largely to parts of the tree near or below the surface of the ground. The parent beetle, about ¾ inch long, has an olive-yellow appearance due to the dense pubescence, the underlying black usually showing as a series of six black spots near the middle.

Systematic watching for the work of this insect and the early destruction of the borers are the most practical control measures.

References

1904, Felt, E. P., and Joutel, L. H., N. Y. State Mus. Bull. 74, pp. 54–58.
1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 91–92.

Lilac Borer

Podosesia syringæ Harris

Whitish or yellowish legless grubs in lilac stems and ash (Fig. 23) very likely belong to this species.

This insect is much better known as a lilac borer than an enemy of the ash, although it occurs in both and is occasionally a somewhat serious pest in lilacs. Infestation is usually indicated by the wilting of individual shoots and the fresh hanging borings, the point of attack occasionally showing a break in the stem. In the Middle West the closely related *Podosesia fraxini* Lugger is credited as being a serious enemy of small ash trees, the pest working more commonly just below the surface of the soil.

Fig. 23.—Lilac borer, work in ash, reduced.

The parent insect is a clear-winged moth resembling a wasp in general color and movement and having a wing spread of 1 to $1\frac{1}{2}$ inches. The eggs are deposited in masses on rough or knotty places and the young larvæ work first in the sapwood and later enter the heartwood and, in the case of lilac, frequently eat away most of the center of the stem. The final transformations occur within the galleries.

Systematic cutting and burning of infested shoots is a most effective control measure which may be supplemented in the case of larger stems by the injection of a little carbon bisulfide into inhabited galleries and the sealing of the opening with grafting wax or similar material.

References

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, p. 92.
1919, Weiss, H. B., N. J. Dept. Agr. Circ. 26, pp. 43–44.

Thorn Limb-Borer

Saperda fayi Bland.

Fig. 24.—Thorn limb-borer, work and adult, reduced.

Oval swellings about an inch long, with four to five longitudinal scars, occur on the small limbs and stems of wild thorn (Fig. 24).

The cinnamon-brown white-marked insect flies the last week of May or early in June. Oviposition probably occurs at night, limbs from $\frac{1}{3}$ to $1\frac{1}{4}$ inches in diameter being selected. Three to six longitudinal incisions about $\frac{3}{4}$ inch long, equally distant and parallel one to another, are made in the bark and an egg placed in each. The grub bores in the outer layer of the wood and produces a somewhat characteristic swelling.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 283–284.

Rose Stem-Girdler

Agrilus viridis Linn.

The work of this insect is indicated by elongated stem swellings sometimes in several places or following spiral or longitudinal lines.

Fig. 25. — Rhododendron clear wing, work, reduced.

The stem-girdler is another recent European introduction which occasionally causes considerable damage to *Rosa rugosa* in New Jersey. The adult is a small, elongate, metallic-colored beetle which is abroad in June and July and deposits eggs singly upon the bark. The young larvæ make spiral bands or channels, these being close together for a distance of 1 to 2½ inches and causing an almost imperceptible to very evident swelling. In many cases the enlargement is marked by shallow longitudinal splitting of the bark. The leaves of infested canes turn yellow, finally withering, and the stem dies, it breaking easily at the point of attack.

Cutting and burning infested canes is the most practical control measure.

Reference

1921, Weiss, H. B., N. J. Dept. Agr. Bur. Stat. & Insp. Circ. 36, pp. 9–10.

Rhododendron Clear Wing

Sesia rhododendri Beutm.

Wilting or yellow rhododendron leaves on small plants or twigs and the occurrence of whitish boring caterpillars just under the bark are characteristic of this insect.

The rhododendron borer limits its operations largely to stems or branches a foot or more above the ground. The young larvæ frequently work just under the bark and in the sapwood, excavating irregular, longitudinal, more or less frass-filled galleries some three inches long and terminating in irregular, oval, sparsely silk-lined cells with a major dimension of 3/8 inch, the hibernating shelters (Fig. 25). There are frequently one or more broad transverse galleries partially girdling the twig. Eggs are deposited singly on the small twigs, the larvæ being half grown late in August and nearly full grown at the end of October. Young plants or small twigs are frequently girdled and soon wilt or die. Larger stems may bear ugly scars on the main stem and branches.

The most effective control measure is to prune out and burn all dead or infested portions of bushes in the fall or winter. Large plants may be protected by first scraping the injured parts and then applying a coat of thick tar paint, one in the fall as a repellant to woodpeckers and another in the spring, preferably in late April or early May, to prevent emergence of the moths.

Fig. 26.—European hornet.

REFERENCE

1915, Felt, E. P., N. Y. State Mus. Bull. 175, pp. 19–21.

EUROPEAN HORNET

Vespa crabro Linn.

Early in June or during July the living twigs of various shrubs and trees may be partly or completely girdled by the removal of the bark (Figs. 26, 27). This is the work of a recently introduced European hornet decidedly larger than the native white-faced hornet, which latter is best known on account of the large hanging paper nests it constructs. This European introduction rarely builds free hanging nests. They are more commonly found within cavities of trees and in confined places in buildings, as between rafters and underground. The paper or wall of the nest is decidedly darker than that of the American species. This giant hairy black hornet with dark yellowish-orange markings is about an inch long. The stripping of bark from twigs of various trees and shrubs has been recorded in Europe as well as in this country. The material damage is limited largely to ornamentals.

Fig. 27.—European hornet, work on birch, reduced.

The most satisfactory control measure is to locate the nest by observation and destroy the contained insects by burning sulfur or with carbon bisulfide, preferably in the early evening. The hornets can be trapped in long-necked flasks containing sweetened water.

Reference

1915, Felt, E. P., N. Y. State Mus Bull. 180, pp. 71–73.

White Ants

Reticulitermes flavipes Kollar

White wingless ant-like creatures occurring in dead stumps or in decaying or other timbers of houses are not uncommon.

White ants are not even closely related to the much better known true ants, although there is a superficial resemblance in form and habits. White ants are peculiar in that they avoid the light and must have a certain degree of moisture, consequently the invasion of any wood is from below and, if a direct entry is not possible, the approach is through a covered gallery. At certain seasons the winged sexed individuals swarm in large numbers and in not a few instances this is the first intimation of their occurrence in a dwelling. White ants breed not only in decaying stumps but also invade living trees, and under certain conditions may cause serious injury, particularly in the southern part of the United States.

Wood in contact with the soil is most likely to be invaded and infestation is more probable in sections in which there is more or less decaying wood, as, for example, in recently cleared woodland areas. These insects, however, will construct covered tunnels if necessary and in that way may ascend concrete piers or other obstacles. It is very easy to destroy these covered avenues of approach and the few ants remaining are unable to maintain themselves unless the connecting passageway is rebuilt. In areas where white ants are prevalent, foundations should be well above the ground and rest upon stone or cement. Wood used in places where infestation is likely to occur should be treated with a 1 per cent solution of bichloride of mercury. Coal tar creosotes and carbolineums have also proved most effective preventives of infestation. If preventive treatment is impossible, the more resistant woods should be employed so far as possible. Trees are invaded only through some scar or wound. A colony within a tree may be destroyed by fumigation with carbon bisulfide and reinfestation prevented by sealing the point of entrance with cement, coal tar or similar materials. Recent investigations have shown that white ants in a building may be destroyed by raising the temperature of the infested parts of the structure to 135° F., and maintaining this heat for a period of twenty-four hours.

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1922, Snyder, T. E., Econ. Ent. Journ. 14:496–501.

Large Carpenter Bee

Xylocopa virginica Drury

Burrows about ½ inch in diameter occasionally may be observed in telegraph poles, door posts and similar places and large-bodied dusky-winged bees may be seen passing in and out (Fig. 28).

Fig. 28.—Large carpenter bee and work, note circular exit hole, reduced.

This carpenter bee is about the size and has the general appearance of a bumblebee, although the abdomen is jet black and frequently somewhat bare. It excavates tunnels in solid wood, sometimes to a distance of a foot or more, in which it constructs cells for the rearing of young.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, p. 484.

CHAPTER IV

LEAF-FEEDERS DESTRUCTIVE TO ORNAMENTAL TREES

THE work of leaf-feeders is easily detected although frequently a considerable injury has been caused before there is any suspicion of insect attacks. Early detection of outbreaks is extremely desirable because young caterpillars, as a rule, are more readily killed by poison than older ones and, furthermore, spraying in an incipient stage of an attack prevents much injury which can not be avoided if operations are delayed until later. It is possible in the case of such leaf-feeders as the white-marked tussock moth and both the apple and forest tent-caterpillars to anticipate the need of spraying by looking for egg masses upon the trees any time during the winter. Preparedness is more than half the battle in controlling insect outbreaks.

KEY TO DESTRUCTIVE LEAF-FEEDERS

General leaf-feeders

Brownish caterpillars with blue and reddish warts and about 2½ inches long, on oak, birch, willow and fruit-trees.

Gipsy moth, *Porthetria dispar* Linn., p. 73.

Small firm webbed tents on the tips of twigs in midwinter and looser webs in late summer, on oak, pear, maple, elm and the like.

Brown-tail moth, *Euproctis chrysorrhœa* Linn., p. 77.

Conspicuous loose webbed tents in July and August inclosing skeletonized browned leaves, on many trees.

Fall webworm, *Hyphantria textor* Harr., p. 79.

Red-headed yellow and black caterpillars with three long black tufts, on horse-chestnut, linden, maple and elm.

White-marked tussock moth, *Hemerocampa leucostigma* Abb. and Sm., p. 80.

Blue-headed caterpillars about 3 inches long and with a row of silvery diamond-shaped spots down the back, on maples, poplars, apple and oak.

Forest tent-caterpillar, *Malacosoma disstria* Hubn., p. 81.

Bag-shaped cases in midsummer contain small caterpillars, on arborvitæ, red cedar and other trees.

Bagworn, *Thyridopteryx ephemeræformis* Haw., p. 83.

Elms

Blister-like mines on the foliage of skeletonized leaves.

Elm leaf-beetle, *Galerucella xanthomelæna* Schrank, p. 84.

Cylindrical coiled yellowish-white worm with a black line down the back, also on willows, poplars and other trees.

Elm sawfly, *Cimbex americana* Leach, p. 86.

Large black red-marked spiny caterpillars about 2 inches long, also on willow and poplar.

Spiny elm caterpillar, *Euvanessa antiopa* Linn., p. 87.

Dark looping caterpillars or measuring worms about 1 inch long, also on other trees.

Canker-worms, *Paleacrita vernata* Peck and *Alsophila pometaria* Harr., p. 88.

Spotted mining of elm leaves and cigar-like cases.

European elm case-bearer, *Coleophora limosipennella* Dup., p. 89.

Circular, somewhat irregular, blister leaf-mines, especially on Camperdown elm.

Elm leaf-miner, *Kaliofenusa ulmi* Sund., p. 91.

Maples

Light green white-marked caterpillars about 2 inches long defoliate soft maple and ash.

Green maple worm, *Xylina antennata* Walk., p. 92.

Pale yellowish-green caterpillars striped with darker green, $1\frac{1}{2}$ inches long.

Green-striped maple worm, *Anisota rubicunda* Fabr., p. 93.

Leaf-stems bored by yellowish larvæ and dropping in June.

Maple leaf-stem borer, *Caulacampus acericaulis* MacG., p. 94.

Locust, black

Irregular circular holes in the leaves or skeletonized foliage.

Locust leaf-miner, *Chalepus dorsalis* Thunb., p. 95.

Willows and poplars

Yellowish beetles about $\frac{1}{2}$ inch long and variably marked with black, or black grubs about $\frac{3}{8}$ of an inch long.

Cottonwood leaf-beetle, *Lina scripta* Fabr., p. 96.

Browned skeletonized leaves bearing metallic blue beetles about $\frac{1}{8}$ of an inch long or dark grubs $\frac{1}{4}$ of an inch long.

Imported willow leaf-beetle, *Plagiodera versicolora* Laich, p. 97.

Midsummer defoliation by somewhat hairy, black, white-mottled caterpillars about 2 inches long.

Satin moth, *Stilpnotia salicis* Linn., p. 99.

Orange-yellow black-spotted false caterpillars about 7/10 of an inch long, limited to Carolina poplar.

Poplar sawfly, *Trichiocampus viminalis* Fabr., p. 100.

Catalpa

Stout green black-marked caterpillars about 3 inches long and with a posterior horn.

Catalpa sphinx, *Ceratomia catalpæ* Bvd., p. 101.

Distorted leaves with browned eye-like spots or distorted pods and tender twigs.

Catalpa midge, *Itonida catalpæ* Comst., p. 102.

Larch

Needles with the tips yellowish or brownish and infested with case-bearers.

Larch case-bearer, *Coleophora laricella* Hubn., p. 103.

Grape and Virginia creeper

Reddish black-ringed caterpillars about 1½ inches long.

Eight-spotted forester, *Alypia octomaculata* Fabr., p. 104.

Rose

Greenish false caterpillars ⅓ to over ½ inch long seriously damage rose foliage.

Rose slugs or rose worms, p. 105.

Grape, rose and other plants

Light yellowish-brown long-legged beetles swarming when grapes are in blossom.

Rose chafer, *Macrodactylus subspinosus* Fabr., p. 106.

Box, ornamental

Irregularly oval swellings or mines in the leaves.

Box leaf-midge, *Monarthropalpus buxi* Lab., p. 107.

Honeysuckle

Yellowish black-spotted orange-banded larvæ about an inch long destroy the leaves.

Honeysuckle sawfly, *Abia inflata* Nort., p. 108.

Holly

Tortuous yellowish or yellowish-brown leaf-mines.

American holly leaf-miner, *Phytomyza ilicicola* Loew, p. 109.

Arbor-vitæ

Brown and mined leaf-tips.

Arbor-vitæ leaf-miner, *Argyresthia thuiella* Pack., p. 110.

Gipsy Moth

Porthetria dispar Linn.

Swarming brownish caterpillars with blue and reddish warts and about $2\frac{1}{2}$ inches when full grown defoliate wood-

Fig. 29.—Gipsy moth, female at rest and two egg masses, reduced.

Fig. 30.—Gipsy moth, pupa and cast larval skin in light web.

land areas in the northeastern United States, being especially partial to oak, birch, willow, poplar, beech, larch and, among fruit-trees, apple.

This European insect (Figs. 29-31) was brought into the country in 1868 or 1869 and is now generally established in most of New England, spreading slowly into adjacent territory in spite of systematic and costly efforts to restrict its distribution. It is one of the most serious forest pests, being particularly dangerous in mixed plantings. The great prolificacy of the insect, and the practical inability of the female to fly, results in very dense irregular infestations with re-

FIG. 31.—Gipsy moth caterpillars.

peated strippings of the trees and in some cases death of the more serious affected woodlands. Pines growing in or near deciduous trees may be defoliated and killed by one stripping, while deciduous trees under certain conditions will survive defoliation for three or more successive seasons. The pest has already cost the country about twenty million dollars and the developments of recent years indicate the practical impossibility of growing trees for timber in badly infested areas.

The gipsy moth winters in characteristic oval egg masses about ½ inch in diameter, covered with short light buff hairs and attached to the underside of limbs, trunks and other hard objects. Hatching occurs from the last of April to the middle of June and feeding extends from about the first of May to the middle of July. The partly and full-grown caterpillars cluster upon the branches and trunks of infested trees when not feeding. Transformations to pupæ occur late in June or early in July in almost any sheltered area, the dark brown pupæ with a few scattering, curved, golden hairs hanging in a light open web. The moths appear from the latter part of June to the last of July and belated individuals may occasionally be found in September. The moderately large whitish females with wavy black marks have a wing spread of about two inches, are practically unable to fly and almost invariably deposit their eggs near the place of pupation. The active flying males are olive-brown, black-marked, have feather-like antennæ and a wing spread of about 1½ inches.

The spread of the gipsy moth is mainly through the shipment of nursery stock, timber and the like, bearing eggs, the drifting in the wind of young caterpillars from elevated badly infested areas and, to a much less extent, the conveyance of caterpillars by automobiles and other agencies. Much has been accomplished by quarantine regulations in preventing the spread of this pest through artificial agencies. The policy followed in Massachusetts of keeping roadside trees comparatively free from the gipsy moth has undoubtedly helped greatly in checking the spread. Cities and towns in the infested area have been compelled to resort to systematic spraying with poisons and in some cases to the annual treatment of egg masses in order to prevent serious injury by this prolific and voracious pest. Recent work has indicated that the judicious removal of favored host plants is of much service in protecting woodland areas.

Thirty years' experience has shown immense possibilities in high-powered spraying outfits capable of thoroughly treating from the ground even the tallest trees. It has also demonstrated the possibility of exterminating isolated infestations even under adverse conditions. This has been applied to comprehensive measures for delaying spread and may even result in the establishment of a barrier zone for the protection of large uninfested areas.

There are no more efficient local control measures than reasonably early and thorough spraying with arsenate of lead, used at the rate of 10 pounds to 100 gallons of water. This should be supplemented in some cases by adhesive bands or other barriers on the trunks to prevent caterpillars ascending the trees. These bands also obviate the necessity of destroying egg masses below such barriers. Serious infestations in orchards can usually be controlled by the amount of poison indicated above and making the first two applications as advised for codlin-moth. Poor or hollow trees should be removed and, if a badly infested woodland is near by, the fruit-trees should be protected with sticky bands.

There is a very extensive literature in relation to this insect and only a few of the more comprehensive works can be cited.

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FIG. 32.—Brown-tail moth, winter nests.

1917, Burgess, A. F., The Gipsy Moth and the Brown-Tail Moth and Their Control, U. S. Dept. Agr. Farmers' Bull. 845, pp. 1–28.
1923, Felt, E. P., and Others, The Gipsy Moth, an Imminent Menace to the Forest and Shade Trees of the State of New York, N. Y. State Dept. Farms and Markets' Bull. 148, pp. 1–58.

BROWN-TAIL MOTH

Euproctis chrysorrhœa Linn.

Small firm webbed tents on the tips of trees in midwinter (Figs. 32, 33) are characteristic of this species, particularly if small reddish caterpillars about ¼ inch long are found within.

This European insect is a serious enemy of fruit-trees, such as pear, apple, plum and cherry, and it also thrives on oak, maple and elm. The snow-white moths with a wing spread of about 1¼ inches and a conspicuous reddish-brown tuft at the tip of the abdomen fly during July and deposit some two to three hundred eggs in brown hair-covered egg masses on the underside of the leaves. They hatch in a short time and the young feed on the surface of the leaves and on the approach of cold weather construct the familiar, firm, hibernating webs. They issue therefrom early in the spring and often attack swelling buds, completing their growth in early June. The insect is especially obnoxious because the urticating hairs of the larvæ frequently produce the well-known brown-tail itch. This insect is easily distinguished from the fall webworm by the smaller firmer webs and their common occurrence upon pear.

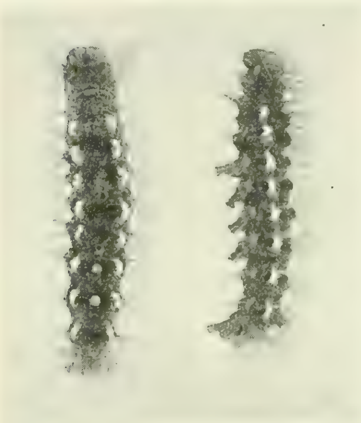

Fig. 33.—Brown-tail moth caterpillars.

The pest is easily controlled on small trees by cutting and burning the hibernating nests during the winter. It is also very susceptible to poison sprays.

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Fall Webworm

Hyphantria textor Harris

Conspicuous web tents in July and August inclosing skeletonized usually brown leaves on the tips of branches are characteristic of this insect.

The fall webworm (Fig. 34) is one of the common late summer feeders which occurs on a considerable variety of trees and is most easily recognized by the filmy webbing at the tips of branches. The nearly snow-white moths fly from early in June to the middle of August and deposit yellowish globular eggs to the number of three hundred or thereabouts on the underside of the leaves and the pale yellowish hairy caterpillars eat away the tender portion of the leaves and as they move about inclose the foliage in filmy webs. The full-grown caterpillars are about 1½ inches long, hairy, yellowish and variably marked with brown and black. Transformation to the adult occurs in a thin oval cocoon spun at or just below the surface of the ground.

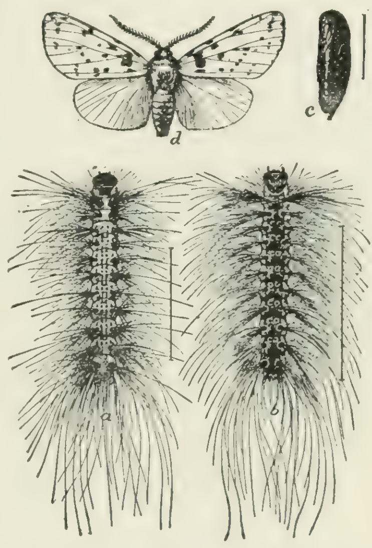

Fig. 34.—Fall webworm, larvæ, adult and pupa, reduced.

It is comparatively easy to crush the insects in their webs when on small trees. The pests are also readily destroyed by an application of poison. The variable abundance of this insect is dependent to a large extent on the efficiency of natural agents. Under certain conditions this can be increased (see the comprehensive study by Tothill cited below).

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White-Marked Tussock Moth

Hemerocampa leucostigma Abb. and Sm.

Red-headed yellow and black caterpillars with three long black tufts (Fig. 35) are sometimes extremely abundant on shade trees, such as horse-chestnut, linden, maple and elm.

Fig. 35.—White-marked tussock moth, caterpillar, male, female, egg mass and cocoons, reduced.

This is one of the common city pests, probably because the English sparrow has driven away the native birds which in earlier years prevented an undue increase. The insect winters in conspicuous egg masses covered by a frothy white substance and having a diameter of approximately half an inch. These are usually attached to the loose open cocoons of the wingless females. The young caterpillars hatch the latter part of May in New York state and begin to feed on the more tender lower surface of the leaf, soon devouring all but the principal veins. Growth is completed in a month or a little more and pupation in the vicinity of Albany, New York, occurs the latter part of June or early in July. The pupal stage occupies ten to fifteen days and the wingless females then emerge and deposit eggs as stated above. There is normally but one generation in Albany, two in Boston and New York City and three in the vicinity of Washington, D. C. The insect is attacked by a considerable series of parasites which aid greatly in keeping the pest down.

The partly grown caterpillars are readily destroyed with arsenical poisons and small trees are most easily protected by removing the whitish egg masses and burning them. Owing to the wingless condition of the females, adjacent uninfested trees may be protected by applying to the trunk sticky bands or bands of loose cotton so as to prevent the ascent of crawling caterpillars.

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Forest Tent-Caterpillar

Malacosoma disstria Hubn.

Blue-headed caterpillars about 2 inches long when full grown and with a line of silvery diamond-shaped spots down the middle of the back occasionally defoliate maples, poplars and oaks in early summer.

This insect (Fig. 36) is one of the common occasionally very destructive forest pests in the northeastern United States. It strips poplars and sugar maples in the Adirondack region, the latter and apple trees in the Hudson Valley and oaks on Long Island. It winters in characteristic light-brown egg belts about half an inch long deposited on the smaller twigs of

FIG. 36.—Forest tent-caterpillar, adult, cocoon, larva, old larval skins and egg mass, reduced.

its favorite host trees. The caterpillars hatch in very early spring. When not feeding they form characteristic clusters, the younger on the branches and the nearly full grown upon the trunks of badly infested trees. Growth is completed about June 1st. The transformation to the moth occurs in oval whitish cocoons spun mostly in leaves, although other convenient shelters are frequently utilized. The moths fly the latter part of June and July, depositing their eggs as stated above.

The insect is closely related to the apple tent-caterpillar, *Malacosoma americana* Fabr., a noteworthy pest of wild cherry trees and also a well-known enemy in the orchard. Both of these species are attacked by numerous parasites and are preyed upon by many birds. The varying activities of these natural agents explain in large measure the periodical abundance of the two.

Both of these pests are easily destroyed by timely and especially early applications of an arsenical poison. This is usually practical only on the more valued shade and orchard trees.

References

1898, Felt, E. P., N. Y. State Mus. Bull. 23, pp. 191–201.
1899, Lowe, V. H., N. Y. Agr. Exp. Sta. Bull. 15, pp. 33–60.
1899, Slingerland, M. V., Cornell Agr. Exp. Sta. Bull. 170, pp. 557–564.
1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 106–115.

Bagworm

Thyridopteryx ephemeræformis Haw.

Various trees are frequently stripped or partly defoliated by small caterpillars in curious bag-like shelters (Fig. 37).

This is one of the more destructive shade-tree pests of New York City and farther south. It has a special fondness for arbor-vitæ and red cedar, although it occurs commonly upon a considerable number of trees and shrubs. The wingless female deposits her eggs within the case in the fall, the young caterpillars appearing some time in May or early June and begin by eating the softer parts of the leaf. They repair to the stems when not feeding and then cover themselves with shelters made by biting off pieces of bark and building them into a silk-lined case which is habitually worn as a protection. The appearance of the case is modified by the pieces of foliage from which it is made—frequently flat bits of leaves are utilized. The caterpillars attain their full size in July or

August and in early September become restless and wander to other trees. The cases themselves, about 2 inches long, are firmly attached to a twig, transformations to adults occur and the eggs are deposited as indicated above.

This insect is readily controlled by timely applications of poison, though in the case of small trees it is frequently more

Fig. 37. — Bagworm, winter case, left, summer case and head of larva, right, enlarged.

satisfactory to remove and burn the cases some time during winter or early spring.

References

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 123–128.
1918, Houser, J. S., Ohio Agr. Exp. Sta. Bull. 332, pp. 215–218.

Elm Leaf-Beetle

Galerucella xanthomelæna Schrank

Irregular circular holes in the leaves or skeletonizing and browning of the foliage in the summer are somewhat characteristic of this insect.

The elm leaf-beetle (Fig. 38) is now well distributed in the eastern United States and is particularly injurious to the European elms, both English and Scotch, though under certain conditions it is very destructive to American elms. It is primarily a city and village pest and appears to thrive best in the vicinity of structures affording suitable winter shelter, such as belfries. It is also more likely to be injurious on streets

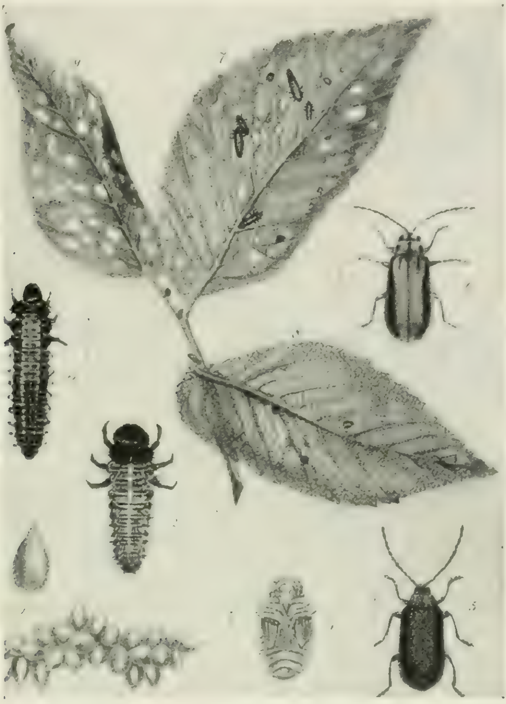

FIG. 38.—Elm leaf-beetle, egg mass, young and full-grown larvæ, pupa, adults, work of grubs and beetles, reduced.

traversed by many vehicles, particularly street-cars. The over-wintering beetles appear in early spring and eat oval holes less than 1/4 inch in diameter in the developing leaves. They begin to deposit clusters of light yellowish-orange eggs on the undersides of the leaves early in June and continue for approximately a month, individual beetles depositing as many as 600. The grubs feed only upon the under surface of the leaf, devouring the more tender part, and complete their growth in fifteen to twenty days. They are then about 1/2 inch long and descend the trees wholly or in part and transform to golden-yellow oval pupæ, the greenish, black-lined beetles about 1/4 inch long issuing therefrom approximately a week later. There is usually but one brood in Albany although about 1898 a partial second generation was commonly produced.

This pest is most easily controlled by early and thorough spraying with a poison. The application should be made when the leaves are about half grown or else early in June, in which event the spray should be thrown upon the under surface of the leaves.

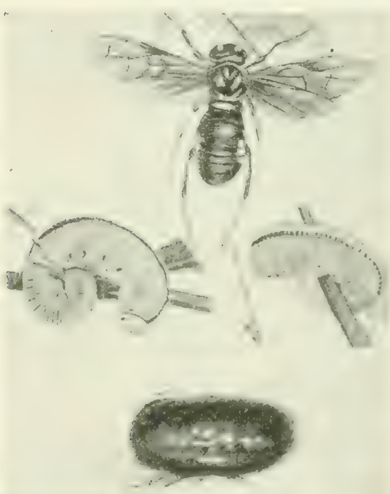

FIG. 39.—Elm sawfly, adult, larva and cocoon.

REFERENCES

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1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 146–155.
1912, Felt, E. P., N. Y. State Mus. Bull. 156, pp. 6–14.

ELM SAWFLY

Cimbex americana Leach

A cylindrical, coiled, yellowish-white worm (Fig. 39), with a black line down the middle of its back, is found in midsummer on willows, elms, poplars and other trees.

This insect occurs in small numbers in the northeastern United States and appears to be much more abundant in the West, particularly in Nebraska, where it has been recorded as defoliating willows. The eggs are laid in small blistered areas in the leaves, the small curled larvæ hatching and feeding upon the foliage. They become full grown the latter part of July or August and then rest in an irregular spiral-shape with a major dimension of 1 inch, the body diameter being about ¼ inch. A tough coarse silken cocoon is spun in the débris at or just below the surface of the ground and the large wasp-like female with a length of about 1 inch, wing spread of 2 inches, a black head and steely blue body appears the following spring.

Ordinarily control measures are not necessary. Spraying with a poison is the most satisfactory remedial treatment.

Reference

1905. Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 155–158.

Spiny Elm Caterpillar

Euvanessa antiopa Linn.

Large, black, red-marked, spiny caterpillars about 2 inches long (Fig. 40) feed in clusters in June and defoliate the terminal branches of elm, willow, poplar and several other trees.

Fig. 40.—Spiny elm caterpillar, eggs, full-grown larva and work, reduced

This is one of the few destructive butterfly caterpillars. The parent butterfly is dark maroon, the wings black, blue-spotted, yellow-bordered and with an expanse of about 3 inches. The yellowish eggs are deposited in naked bands around the smaller twigs. The recently hatched caterpillars are brown, black and hairy and as they increase in size the arge spines and the somewhat diamond-shaped red spots down the middle of the back become apparent. There are two generations, the caterpillars of the first brood becoming full grown the latter part of June or early in July, and those of the second in August and September.

An early application of poison is the most satisfactory method of checking this pest, although as a rule such treatment is unnecessary.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 158–162.

Canker-Worms

Paleacrita vernata Peck and *Alsophila pometaria* Harr.

Dark looping caterpillars or measuring-worms about an inch long defoliate elms and other trees in early spring.

The canker-worms are best known as pests of the orchard, the trees appearing in June as though swept by fire. They also feed on a variety of trees and occasionally are very injurious to elms in particular.

The spring canker-worm, *Paleacrita vernata*, is the common injurious species in the northern United States. The yellowish-green ovál eggs are deposited in early spring by the wingless females in irregular pits or clusters on the trunks and branches. They hatch at about the time the leaves begin to push out of the buds. The caterpillars feed voraciously, completing their growth the latter part of May. They are then about an inch long, vary in color from a light mottled yellowish-brown to dull black and may be distinguished from the frequently associated fall canker-worms by the presence of but two pairs of pro-legs.

The fall canker-worm, *Alsophila pometaria,* is often associated with the spring canker-worm. The wingless females deposit their dark gray, tiny, flower-pot-shaped eggs on the bark in somewhat regular clusters and mostly in late fall, although occasionally not until spring. The eggs hatch about the time the leaves begin to push out of the bud, the caterpillars completing their growth the latter part of May and being then about an inch long, mostly black, usually with three narrow white stripes and a broader lemon-yellow stripe on each side. These measuring-worms are easily distinguished from those of the spring canker-worm by the presence of three pairs of pro-legs.

Since both of these insects undergo their transformations in the ground and the females are wingless, trees can readily be protected by the application of sticky adhesive bands. They should be applied in October and kept in effective condition during moderate weather until into April in order to prevent the moths of both species from ascending the trees. An early spring application of arsenate of lead, six pounds of paste to 100 gallons of water, is very effective. In the case of large trees seriously affected only by canker-worms, it is probable that systematic banding would be more satisfactory.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, p. 547.
1922, Quaintance, A. L., U. S. Dept. Agr. Farmers' Bull. 1270, pp. 33–37.

European Elm Case-Bearer

Coleophora limosipennella Dup.

Angularly spotted mining of elm leaves and the presence of somewhat flattened, very minute, cigar-shaped cases on the foliage are characteristic of this pest (Fig. 41).

The work of this insect, another recent European invader, is indicated by somewhat rectangular, mined areas upon the leaves, each with a small hole about the size of a pin head near the center and limited on two sides by the principal veins. These mined areas quickly turn brown and give a peculiar spotted appearance to affected trees. The cause of the trouble

FIG. 41.—European elm case-bearer, work, reduced, a small portion enlarged and showing feeding holes.

is a small caterpillar which lives in a light brown, cylindrical, somewhat flattened case about 3/8 inch in length. It eats a small hole into the leaf and then stretching from this point of entry devours all of the softer green tissues which can be reached without deserting the sheltering case. The moths are in flight the latter part of July. The winter is passed in a partly grown condition, the hibernating larvæ, as in the case of the related apple case-bearers, attacking the leaves as soon as they appear and in some instances mining them so completely that the foliage is practically destroyed. This European case-bearer is somewhat local in its operations and certain groups of trees may be very seriously affected, the English and Scotch elms being favorites. This newly introduced pest is well established in southeastern New York and adjacent areas.

Early and thorough spraying with an arsenical poison is the most effective control measure. Data indicate that equally good results might follow the use of a lime-sulfur wash at winter strength.

REFERENCE

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 167–168.

ELM LEAF-MINER

Kaliofenusa ulmi Sund.

FIG. 42.—Elm leaf-miner, work, reduced.

Circular somewhat irregular blister mines in elm leaves (Fig. 42), especially the Camperdown elms, are the work of this recently introduced pest.

The small shining black sawflies about ⅛ inch long deposit their eggs in the leaves the latter part of May. The legless grubs work between the upper and lower surface, producing rather characteristic irregular blistered areas and desert the leaves the latter part of June or very early in July, enter the ground and spin brown papery cocoons in which they winter, the parent insects appearing the following May. Natural enemies are holding this insect in check much more satisfactorily than in 1898 when it was first discovered in this country. Spraying early in June with a tobacco soap preparation has proved very effective in destroying the grubs within their mines.

A closely related species designated as the European alder sawfly, *Kaliosysphinga dohrnii* Tishb., was already established in New York state in 1891. Its habits are similar to the better known elm species and it can be controlled by the same treatment. A brief account is given by Slingerland (See *infra*, pp. 58–62). There is also a good one by Swaine.

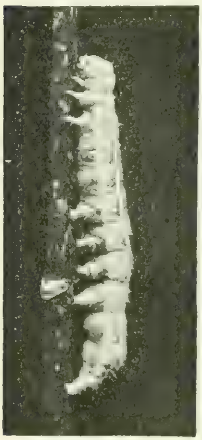

Fig. 43. — Green maple worm.

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1912, Herrick, G. W., Journ. Econ. Ent. 5:171–172.
1917, Swaine, J. M., Ent. Soc. Ont., 47th Rept., pp. 97–100.

Green Maple Worm

Xylina antennata Walker

Light green white-marked caterpillars occasionally defoliate soft maple and ash in early summer (Fig. 43).

This insect is one of the very occasional leaf-feeders which sometimes appears in immense numbers. It has a marked preference for soft maples and usually the injury is limited to wild growth along river banks or woodlands and it is only occasionally that shade trees are molested. The caterpillars are not usually observed till May or early June, at which time they are about half grown. They become full grown the last of June, enter the ground, pupate and most of the moths issue in September and winter, although some pupæ hibernate. The eggs are said to be deposited upon the under surface of the leaves. The caterpillar, when full grown, is 1 to 1½ inches long, rather stout, smooth, light green with yellowish-white or white stripes along the body and a pale yellowish-green head.

Birds are very effective checks on this insect and ordinarily they and parasites prevent it becoming excessively abundant. It is also susceptible to arsenical poisons.

References

1898, Felt, E. P., N. Y. State Mus. Bull. 23, pp. 207–212.
1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 129–132.
1912, Felt, E. P., N. Y. State Mus. Bull. 155, pp. 48–52.

Green-Striped Maple Worm

Anisota rubicunda Fabr.

A large pale yellowish-green caterpillar striped with darker green occasionally defoliates maples.

This is a native widely distributed insect which sometimes occurs in such numbers as to defoliate considerable areas in midsummer. It appears to be a most serious pest in the western states. The full-grown caterpillar is about 1½ inches long, pale yellowish-green, longitudinally striped above alternately with eight very light yellowish-green lines and seven of a darker green, inclining to black. There are two slender black spines on the second segment behind the head and two lateral rows of sharper shorter spines. The head is yellowish, abdominal segments seven and eight are a little dilated and rose-colored on the sides. The moth is rose-colored, the wing spread about 2 inches, the fore-wings being crossed by a broad pale yellowish band.

REFERENCE

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 537–538.

MAPLE LEAF-STEM BORER

Caulacampus acericaulis MacG.

Dropping of maple leaves in June may be due to the work of a larva boring in the leaf-stalk.

The yellowish nearly legless sawfly larva only 1/3 inch long when full grown tunnels the leaf-stalks of various maples in June (Fig. 44), frequently causing serious dropping from the lower branches in particular. Until within recent years it was supposed that two Microlepidoptera, *Steganoptycha claypoliana* Riley and *Proteoteras æsculana* Riley, were responsible for most of this injury, which is not the case in the northeastern United States, although it may be true of Ohio and farther west, particularly of the borers working in the leaf-stems of buckeye.

FIG. 44.—Maple leaf-stem borer, severed stem and injured stem sectioned and enlarged.

The fact that this sawfly works almost entirely in the lower leaves would make it comparatively easy to pick and destroy the infested leaves about mid-June and this might well be supplemented in the case of trees standing on closely clipped lawns by picking up the infested stems as soon as they begin to fall in numbers and burning them with the contained larvæ. There is a possibility that spraying the ground under the infested trees with a contact insecticide, such as kerosene emulsion, would destroy many of the borers.

REFERENCES

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1912, Britton, W. E., Conn. State Ent., 11th Rept., pp. 305–307.
1918, Felt, E. P., N. Y. State Mus. Bull. 198, pp. 63–64.

LOCUST LEAF-MINER

Chalepus dorsalis Thunb.

Blister-like spots or eroded skeletonized brown or dead areas on black locust leaves are common (Fig. 45), sometimes generally present and accompanied by the death of the foliage in midsummer over wide areas.

FIG. 45.—Locust leaf-miner, work of beetles.

Occasionally the black locusts of the eastern United States, particularly in the West Virginia section, Ohio and on Long Island, may be so badly affected by this insect and the closely related rosy hispa, *Anoplitis inæqualis* Web. (*Chalepus nervosa* Panz), that large areas will show only browned dead foliage or no leaves in midsummer. This condition is caused by a small, reddish black-marked beetle about 1/4 inch long, which winters in sheltered places, appears as soon as the leaves have fully developed, eats small holes and later in the season skeletonizes the upper surface. The eggs are laid on the underside of the leaves, partly under an excretion; they hatch in about six to eight days and the larvæ excavate somewhat irregularly circular mines, two or three weeks probably being required to complete growth.

A very considerable degree of protection has been secured by thorough spraying with a poison, first just after the leaves are fully developed and secondly the latter part of July, the latter being applied especially to the under surface of the leaf and directed against the rosy hispa. The smooth surface of the locust leaf makes advisable the use of an adhesive or spreader.

References

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 325–329.
1912, Felt, E. P., N. Y. State Mus. Bull. 155, pp. 59–65.
1913, Felt, E. P., N. Y. State Mus. Bull. 165, p. 100.
1918, Houser, J. S., Ohio Agr. Exp. Sta. Bull. 332, pp. 231–236.

Cottonwood Leaf-Beetle

Lina scripta Fabr.

Yellowish beetles about $\frac{1}{2}$ inch long, variably marked with elongated black spots or blackened grubs about $\frac{3}{8}$ inch in length, frequently defoliate willows and poplars (Fig. 46), especially in the western states. They have also proved a serious enemy of the European osier or basket willow grown in central New York.

The beetles appear in early spring and feed on the tender shoots. This causes the basket willows to branch and renders them nearly useless for commercial purposes. The yellowish or reddish eggs are deposited in clusters on the under surface of the leaves and the nearly black grubs skeletonize the lower surface of the foliage. The immature stages require fifteen days in midsummer. There are probably five broods in the West, and possibly three or four in New York state, where the insect is credited with disappearing from the basket willows about the first of August. The species presumably occurs throughout most of the northern United States.

Early and thorough spraying with an arsenical poison is the most practical method of controlling this insect on ornamental willows or in commercial plantings, although a beetle catcher has been used with some degree of success.

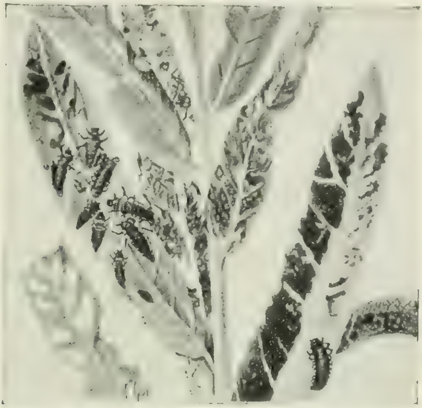

FIG. 46.—Cottonwood leaf-beetle, eggs, grubs and their work.

REFERENCES

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1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 317–322.

IMPORTED WILLOW LEAF-BEETLE

Plagiodera versicolora Laich.

Browned skeletonized willow foliage is often caused by metallic blue beetles about 1/8 inch long or dark grubs about 1/4 inch long (Fig. 47).

This European leaf-beetle has recently become established in the vicinity of New York City, increasing enormously on groups of willows and in some cases practically destroying the foliage in midsummer. The species displays a marked preference for the black willow and was also observed upon the golden and weeping willow. It also feeds on poplar. The

FIG. 47.—Imported willow leaf-beetle, beetle, grubs and their work, pupa enlarged.

beetles of the first brood appear in late April or early May and those of the second in early June and continue to issue until into July. The adult is a moderately stout metallic blue beetle about ⅛ inch long and closely resembling several flea-beetles, though it does not have equal jumping powers.

Early and thorough spraying or dusting with an arsenical poison should control this insect on ornamentals. The application should be made to the underside of the foliage because the grubs feed only upon the lower surface of the leaves.

Reference

1919, Weiss, H. B., N. J. Dept. Agr. Circ. 26, pp. 18–19.

Satin Moth

Stilpnotia salicis Linn.

Midsummer defoliation of poplars and willows may be caused by a somewhat hairy, black white-mottled caterpillar.

Fig. 48.—Satin moth.

The satin moth, a recently introduced European species, has become established over a considerable area in eastern Massachusetts and also in the vicinity of Vancouver, British Columbia. It is related to the much better known and more generally distributed brown-tail moth. It feeds largely upon poplars and willows and becomes sufficiently abundant locally to defoliate individual trees, or groups of trees. The moth (Fig. 48) is larger than any of the snow-white insects, it having a wing spread of 1½ to over 2 inches, the smaller being males, and a peculiar satiny texture which suggests the common name. The young caterpillars winter like those of the brown-tail moth except that hibernation, mostly singly, is in protectively colored silken pockets on the bark of the branches as well as the trunk. The full-grown caterpillars (Fig. 49) are about 2 inches long with a bluish-black head and a black body with irregular white markings, and spots down the middle of the back suggestive of those of the forest tent-caterpillar. The insect feeds on the relatively unimportant willow and poplar, although there is an English record to the effect that it also occurs upon oak.

Fig. 49.—Satin moth larva, enlarged.

Early spraying with an arsenical poison to which a sticker has been added, is a most promising control method when such measures are justified.

Reference

1921, Burgess, A. F., U. S. Dept. Agr., Dept. Circ. 167, pp. 3–16.

Poplar Sawfly

Trichiocampus viminalis Fabr.

The orange-yellow black-spotted false caterpillars feed side by side rather commonly on Carolina poplar leaves in the early part of June.

This European insect attracted notice in 1888 on account of its defoliating poplars. The larvæ have been found rather commonly on Carolina poplar in recent years and caused some apprehension. The full-grown larva is about $7/10$ inch long, orange-yellow with two rows of large irregularly rounded black spots down the back and rows of smaller ones on each side. It has a black head and is sparsely clothed with numerous short whitish hairs. The first brood completes its growth the last of June and the second appears in August.

Spraying with an arsenical poison is recommended if the infestation is sufficiently severe.

REFERENCE

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 568–569.

CATALPA SPHINX

Ceratomia catalpæ Bvd.

Catalpas are often defoliated by a large dark green black-marked caterpillar with a posterior horn.

The catalpa sphinx is sometimes extremely abundant, particularly in southern Ohio, and may strip groves of catalpas and occasionally entire plantations may be killed as a result of successive attacks (Fig. 50). This insect is best known on account of its resemblance to the tomato or tobacco horn-worm. It is about 3 inches long when full grown, dark green with black markings and a well-developed horn at the posterior extremity.

FIG. 50.—Catalpa sphinx, work.

The winter is passed as a pupa. The moths issue shortly after the appearance of the catalpa foliage in the spring, deposit their eggs, the larvæ feeding gregariously for a time and developing rapidly, the eggs and caterpillars of a second brood being found in late July and early August. This insect is most abundant east and south of the Mississippi and Ohio rivers and in parts of Ohio, Indiana and Illinois.

The catalpa sphinx is easily destroyed by poison applications. Dusting infested trees with powdered arsenate of lead distributed from an aeroplane has proved a very satisfactory method.

Reference

1918, Houser, J. S., Ohio Agr. Exp Sta. Bull. 332, pp. 238–241.

Catalpa Midge.

Itonida catalpæ Comst.

Distorted leaves, browned eye-like spots or larger browned areas on the leaves, distorted pods and slightly swollen blackened tender twigs followed by excessive branching are all the work of this pest.

The parent insect is a fragile yellowish midge only about $\frac{1}{16}$ inch in length which emerges presumably from the soil in late May and early June and deposits great quantities of eggs in the buds and upon the unfolding leaves. Maggots occur in abundance at Wooster, Ohio, as early as June 5th. Some transform to adults within the affected parts of the host, although a larger number probably drop to the ground. The full-grown maggot is about $\frac{1}{8}$ inch long, varies in color from pale whitish to orange and may be recognized easily by its springing into the air to a height of several inches, this being accomplished by bringing the extremities of the body together, forming a bow and then suddenly straightening out. The insect causes serious injury by stunting and dwarfing the leaves as a result of the constant killing back of the terminal bud. Repeated injury results in excessive branching and a dwarfed bushy growth instead of a straight upright tree.

No satisfactory control measures have been demonstrated. There is a possibility of trapping many of the midges by spraying the trees in late May, at the time the insects are just beginning to fly, with a molasses solution, using about six pounds of molasses to 50 gallons of water.

References

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1890, Packard, A. S., U. S. Ent. Com. Fifth Rept., pp. 666–668 (*Diplosis*).
1908, Gossard, H. A., Ohio Agr. Exp. Sta. Bull. 197, pp. 1–3 (*Cecidomyia*).
1918, Houser, J. S., Ohio Agr. Exp. Sta. Bull. 332, pp. 312–314.
1921, Felt, E. P., N. Y. State Mus. Bull. 231–232, pp. 194–195.

Larch Case-Bearer

Coleophora laricella Hubn.

The tips of larch needles sometimes turn yellow or brown, the work of a brown black-headed case-bearing caterpillar about ¼ inch long (Fig. 51).

This European case-bearer was first recorded in this country in 1886. It appears to be somewhat widely distributed in the northeastern United States at least and occasionally becomes sufficiently abundant rather seriously to injure the host tree. The small delicate gray moths occur in June or July and the recently hatched caterpillars appear to content themselves with mining in a leaf until the mine is big enough to form a case. It is then cut off and functions as a movable shelter. It is at first whitish but gradually becomes gray. The case-bearers winter upon the smaller branches and resume feeding in early spring, at which time they cause the greatest mischief.

The larch case-bearer is easily controlled by thorough spraying with an arsenical poison or by the application of a lime-sulfur wash at winter strength in early spring.

FIG. 51.—Larch case-bearer, mined tips of leaves, larva partly out of case, eggs natural size; also larch sawfly larvæ.

REFERENCES

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 170–171.
1912, Herrick, G. W., Econ. Ent. Journ. 5:172.

EIGHT-SPOTTED FORESTER

Alypia octomaculata Fabr.

Reddish black-ringed caterpillars about 1½ inches long feed from June into August on Virginia creeper and grapevine.

The strikingly marked caterpillar of this species (Figs. 52, 53) is occasionally quite injurious to Ampelopsis or Virginia creeper as well as grapevine. It is easily recognized by its reddish color with the sharply defined black rings, and can readily be controlled by spraying with an arsenical poison. The adult is a beautiful black moth with eight large lemon-yellow spots on its wings, which latter have a spread of 1½ inches.

REFERENCES

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, p. 575.
1917, Lowry, Q. S., Econ. Ent. Journ. 10:47.

FIG. 52.—Eight-spotted forester, larvæ.

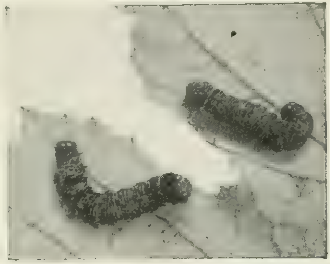

FIG. 53.—Eight-spotted forester, larvæ.

ROSE SLUGS OR ROSE WORMS

Greenish false caterpillars some ⅓ to over ½ inch long skeletonize and seriously damage rose foliage.

The American rose slug, *Endelomyia rosæ* Harr., is the smallest of the three species which attack the rose, is only about ⅓ inch long when full grown, greenish and slug-like. The adults issue early in the spring, about the first of April in the District of Columbia and the third week in May or even not till the middle of June in Massachusetts. The eggs are inserted in incisions in the leaves and the slugs skeletonize the foliage, working for a period of five or six weeks. This is a common destructive species in New York state.

The bristly rose slug, *Cladius pectinicornis* Four, is a little over ½ inch long when full grown, yellowish or greenish in color and most easily recognized by the bristly armor or spines. The eggs are deposited in slits in the upper surface of the leaf-stem in late April and early May in the District of Columbia, a second generation beginning work about the second week in July. The slugs skeletonize the leaves in the earlier stages, eating large irregular holes later.

The coiled rose slug, *Emphytus cinctus* Linn., is most easily recognized by the characteristic curled posterior extremity. The full-grown larva is about $\frac{3}{4}$ inch long, perfectly smooth, and metallic green with numerous white dots. This insect produces two and possibly three generations. The eggs are deposited upon the under surface of the leaves, the slugs feeding along the edges and eating out irregular areas.

All of the slugs are readily destroyed by timely spraying with poison, although in many cases hellebore at the rate of one ounce to two or three gallons of water or a tobacco soap preparation is preferable, the applications being made when the young slugs are numerous and before appreciable injury has been caused. In the case of the species with two or three broods, roses should be watched rather closely throughout the season.

Reference

1908, Chittenden, F. H., U. S. Dept. Agr., Bur. Ent. Circ. 105, pp. 1-12.

Fig. 54.—Rose chafer and grub.

Rose Chafer

Macrodactylus subspinosus Fabr.

Light yellowish-brown long-legged beetles (Fig. 54) about $\frac{1}{3}$ inch long swarm upon roses and a number of other plants.

The rose beetle or chafer is a notorious pest in sandy areas, appearing at about the time grapes are in blossom. The white grubs of this insect, nearly $\frac{1}{2}$ inch when full grown, live on the roots of various grasses growing in sandy areas. The adults issue in large numbers and attack many plants.

The rose chafer is most abundant in or near wild sandy areas. The growth of cultivated crops is unfavorable to its development. Valued plants can be protected to a considerable extent by thorough spraying with a poison, such as arsenate of lead, using ten pounds of the paste to 100 gallons of water. A few small trees or shrubs may be protected with mosquito netting.

Box Leaf-Midge

Monarthropalpus buxi Lab.

Fig. 55.—Box leaf-midge, affected leaves, enlarged.

More or less irregular oval swellings on the leaves, each marking an eccentric, oval, clear space mined beneath by one or more pale yellowish-white maggots about $\frac{1}{16}$ inch long, are an early sign of infestation (Fig. 55). Badly affected plants may have lost many of the older leaves.

The box leaf-midge is a recent European introduction now well established from Rhode Island southward at least to the latitude of Washington. It has become extremely abundant and very injurious in some box plantings. Badly infested leaves may contain six or more of the maggots and most of the foliage under such conditions may be nearly destroyed. Badly infested box in mid-June may have the leaves fairly bristling with the whitish "casts" from which the yellowish midges, with a length of approximately $\frac{1}{10}$ inch, issue in swarms the latter part of May or early in June. A very small proportion of the maggots may remain unchanged toward the end of June. The eggs are deposited in slits in the foliage late in May or early in June. The first evidence of attack is a slight change in color and then an increase in size of the discolored areas accompanied by more or less swelling. Toward the end of the season these may extend to the edge of the leaf and if there are several maggots they may unite. The maggots winter within the leaves, the flies appearing the following spring.

Spraying with a molasses solution has given excellent results, using four to six pounds of molasses to 50 gallons of water and making the application just as the midges begin to issue from the leaves and repeating the treatment, if the best possible protection is desired, every two days during the time the small yellowish flies are numerous, usually for ten days or two weeks. The precise time to begin spraying can be ascertained by looking for the delicate yellowish "skins" or "casts" protruding from the under surface of the leaves. Some gardeners believe they have obtained better results by adding to the molasses solution a general insecticide containing nicotine, soap and miscible oil. The latter would probably destroy recently hatched maggots and be particularly desirable in the later applications.

References

1915, Felt, E. P., N. Y. State Mus. Bull. 180, pp. 42–46.
1921, Felt, E. P., N. Y. State Mus. Bull. 231–232, pp. 236–238.

Honeysuckle Sawfly

Abia inflata Nort.

Yellow, black-spotted, partly orange-banded sawfly larvæ occasionally defoliate honeysuckle.

The honeysuckle sawfly larvæ are rather common on Lonicera in the vicinity of New York City, occasionally partly stripping the vines early in June. These false caterpillars are about 1 inch long when full grown. The head is brown, the body mostly yellowish and sooty yellowish with a broad, variable yellowish stripe broken by a series of rectangular spots down the middle of the back.

Injury may be prevented by spraying with a tobacco soap combination or arsenate of lead before the pests are half grown.

Reference

1912, Felt, E. P., N. Y. State Mus. Bull. 155, pp. 114–115.

American Holly Leaf-Miner

Phytomyza ilicicola Loew

Tortuous yellowish or yellowish-brown mines in the rich green leaves of holly are produced by the maggot of this leaf-miner.

The latter part of May old affected leaves contain numerous puparia from which the flies emerge in due time. The eggs are laid presumably on the underside of the leaves and the young maggots work in the foliage through most of the season, probably winter in this condition and transform to puparia the following spring. It is certain that the insect winters in the leaves. This American insect is probably closely related to the European *Phytomyza ilicis* Kalt., a species recorded as abundant in certain English localities.

Since holly leaves remain on the trees for two years or more and the holly leaf-miner is found therein for but one season, the destruction of the fallen leaves would have no effect on the miner, because by the time they dropped the insects would have deserted that part of the foliage. The most promising method of controlling the miner is to spray with tobacco soap solution, such as three-quarters of a pint of Black-Leaf 40 to 100 gallons of water to which should be added a spreader, such as casein, or six to eight pounds of any cheap soap. The first application should be made the last of

May or very early in June and the trees then watched and if there are signs of small mines in the new foliage in late June or July the spraying should be repeated. This latter treatment presumably will be more effective if given just after the insects have commenced their mining operations and the injury is, therefore, relatively inconspicuous.

Arbor-Vitæ Leaf-Miner

Argyresthia thuiella Pack.

The tips of arbor-vitæ leaves turn brown, a condition resulting from the interior being mined by a small caterpillar (Fig. 56).

Fig. 56.—Arbor-vitæ leaf-miner, work, reduced.

The eggs are probably deposited in the summer, the young larvæ mining the leaves of the preceding year and becoming nearly full grown toward the end of the season. They are then about $\frac{1}{10}$ inch long, mostly yellowish, the head a variable yellowish and dark brown. The moths issue the following June.

Cutting off and burning the infested leaves in fall or early spring would destroy many of the pests. Thorough spraying with a tobacco soap preparation early in July very probably would destroy many of the young caterpillars.

Reference

1915, Felt, E. P., N. Y. State Mus. Bull. 175, pp. 22–24.

CHAPTER V

PLANT GALLS AND GALL INSECTS

A VERY large number of insects belonging to diverse groups produce deformations or galls upon a great variety of plants, although most species of gall insects are rather closely restricted not only to specific or nearly related plants but frequently to special parts, such as the seed, the bud, the leaf, leaf-stem, twig or branch, stem or trunk and root. Practically speaking, every part of all plants may be attacked by one or more gall insects and compelled not only to provide food but shelter for the insect.

The development of gall-making habits among insects, as well as modifications in other lines, has been a gradual one and it is comparatively easy to find all stages in the process from the simple wrinkle or fold, which might or might not be considered a gall, to the highly modified seed, leaf or other part of the plant exhibiting such a great change that its true nature can be established only with difficulty. Many species attack trees of various kinds, although practically all having such habits are of minor importance.

The Cynipidæ or gall wasps constitute one of the larger and best-known group of gall-makers. These highly specialized insects attack plants referable to only seven botanical families and assignable to but nineteen plant genera, by far the greater proportion of the numerous species living upon oaks and producing an enormous variety of deformations in the acorns, buds, leaves, twigs and roots and incidentally exhibiting a most interesting specialization known as the alternation of generations. That is, the succeeding generation in many of these gall wasps is so different, frequently developing in a very different gall, that it has heretofore been referred to a distinct genus. The second generation following produces the same type of gall and is identical in structure with the grandparents. Some of the twig gall-makers on certain oaks are occasionally extremely abundant and may produce an unhealthy condition in the twigs and branches and at times even cause the death of trees.

The gall-midges or Itonididæ are another extremely large group of gall-makers and, unlike the Cynipidæ, they do not present such extremes in specialization and narrow limitations in hosts, although there are marked preferences for the members of certain botanical families, such as the willows in the Salicaceæ, the hickories of the Juglandaceæ and various Compositæ, particularly Solidago, Aster and Artemisia. A comparatively few gall-midges attack trees. These may be considered at most only moderately injurious and, as a rule, negligible or nearly so.

The plant-lice or Aphididæ contain a number of gall-making forms. The Phylloxeras occur in great numbers on a considerable variety of hickories, although one species breeds commonly upon grape. One gall-making aphid, which occurs on birch and witch-hazel, has a very complex and most interesting life history.

The jumping plant-lice or Psyllidæ contain one genus, Pachypsylla, remarkable for its extreme abundance on hackberry or Celtis, a variety of galls being produced by a series of closely related species.

Galls of a largely mechanical type are produced by various borers belonging to the Coleoptera or beetles and the Lepidoptera, particularly the moths. However, there is not in these groups any such well developed and somewhat closely restricted gall-making habit as occurs in the earlier-mentioned families.

The plant-mites or Eriophyidæ, although not belonging with insects strictly speaking, deserve mention, since they produce a great variety of deformations on many different plants, some of these galls closely approaching in general appearance those produced by insects. Plant-mite galls are usually easily distinguished by the more or less distinct opening or entrance and the excessive development of hairs. A number of species of gall-mites live in small areas of greatly developed plant-hairs known as Erinea. Many of the more complex galls produced by these forms are simply leaf-folds or pouches, the orifice being surrounded by somewhat characteristic plant-hairs. A very common pouch gall on soft maple and a less abundant nail-like gall on hard maple are produced by plant-mites.

A summary of insect galls, containing a large number of illustrations, may be found in New York State Museum Bulletin 200, 1918.

Key to Insect Galls

Oak

White, pink-marked, woolly twig growth, 1 to 1½ inches in diameter, on white oak in June.

Wool sower, *Andricus seminator* Harr., p. 115.

Rough, hard, scaly twig swellings about 1½ inches in diameter, on red oaks.

Gouty oak gall, *Andricus punctatus* Bass., p. 116.

Irregularly rounded, horned, woody twig-gall, diameter ½ to 1½ inches, on various oaks.

Horned oak gall, *Andricus cornigerus* O. S., p. 116.

Conical strongly ribbed galls about 3/16 inch long, crowded in longitudinal cracks, on twigs.

Ribbed bud-gall, *Andricus gemmarius* Ashm., p. 117.

Subglobular, woody, apical twig-galls ½ to 1 inch long, on white oak.

White oak club-gall, *Andricus clavula* O. S., p. 117.

Densely clustered, irregular, reddish-tinted twig or mid-rib leaf-galls, dimensions 1/4 to 1/2 inch.
Oak fig gall, *Biorhiza forticornis* Walsh, p. 117.
Bullet-shaped twig-galls with a diameter of approximately 1/2 inch.
Bullet-galls, *Disholcaspis* spp., p. 119.
Globose, greenish or brown leaf-galls, diameter 1 1/2 inches.
Oak apples, *Amphibolips* spp., p. 119.
Irregularly rounded, hard, woody leaf-galls, dimensions 1/8 to 1/4 inch.
Warty oak leaf-gall, *Cincticornia pilulæ* O. S., p. 120.

Rose
Numerous galls on leaves, branches and roots are produced by a number of species.
Rose galls, *Rhodites* spp., p. 120.

Maple, soft
Circular, eye-like, reddish, yellow-margined leaf-spots.
Ocellate maple leaf-gall, *Cecidomyia ocellaris* O. S., p. 121.
Bladder-like, green or reddish leaf-galls, diameter 1/10 of an inch.
Bladder maple gall, *Phyllocoptes quadripes* Shim., p. 125.

Elm
Comb-like, greenish, usually red-tipped galls between leaf-veins.
Cockscomb elm gall, *Colopha ulmicola* Fitch, p. 126.

Birch
Deformed catkins and greatly swollen seed capsules.
Birch-seed gall-midge, *Oligotrophus betulæ* Winn., 121.

Spruce
Conical many-celled galls about 3/4 inch long, on Norway spruce.
Spruce gall-aphid, *Chermes abietis* Linn., p. 128.
Elongate twig galls, 1/2 to 3 inches long, on Sitka spruce.
Sitka spruce gall, *Gillettea cooleyi* Gill., p. 130.

Balsam
Oval enlargements at the base of the needles.
Balsam gall-midge, *Cecidomyia balsamicola* Lintn., p. 121.

Willow
Cone-like apical twig deformities about an inch long.
Willow cone-gall, *Rhabdophaga strobiloides* Walsh, p. 122.
Irregular fusiform stem swellings on basket willow.
European willow gall-midge, *Rhabdophaga salicis* Schrk., p. 131.

Poplar
Folded convolute masses of poplar leaves.
Vagabond gall, *Pemphigus vagabundus* Walsh, p. 124.
Oval somewhat elongate petiole-galls.
Poplar leaf-stem gall, *Pemphigus populi-transversus* Riley, p. 124.

Witch-hazel
Conical red-tipped leaf-galls, ½ inch long.
Witch-hazel cone-gall, *Hormaphis hamamelidis* Fitch, p. 123.
Many spined, green or reddish, oval bud-galls, ¾ inch long.
Spiny witch-hazel gall, *Hamamelistes spinosus* Shim., p. 123.

Hickory
Globose or conical frequently abundant leaf-galls.
Phylloxera spp., p. 131.
Bullet-like, hollow, green or black galls on leaf, stems or twigs.
Hickory gall-aphid, *Phylloxera caryæcaulis* Fitch, p. 131.

Hackberry
A number of leaf- and twig-galls.
Pachypsylla spp., p. 125.

Grape
Warty leaf-galls about ⅛ inch in diameter.
Grape phylloxera, *Phylloxera vitifoliæ* Fitch, p. 124.

Ash
Fringed lobulate flower masses, diameters ¼ to ¾ inch.
Ash flower-gall, *Eriophyes fraxiniflora* Felt, p. 127.

For information on the following galls, see E. P. Felt, New York State Museum Memoir 8, 1906, vol. 2, pp. 622–685.

Wool Sower

Andricus seminator Harr.

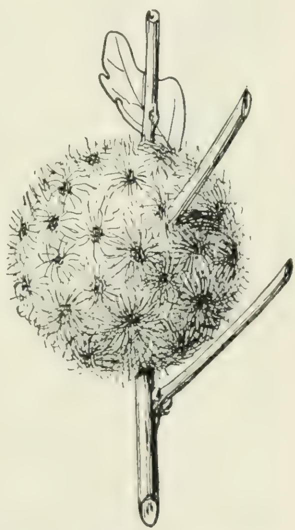

Fig. 57.—Gall of wool sower.

The white, pinkish-marked, woolly growth 1 to 1½ inches in diameter produced by this insect encircles the small twigs of white oak in June (Fig. 57). This is one of the most beautiful structures in nature, the delicate creamy-white being admirably set off by blotches of bright pinkish-red. Large numbers of flies may issue in June. There is a very similar wool oak gall, *A. operator* Osten Sacken, the alternate generation of which produces a pip-like gall aborting the acorns.

Gouty Oak Gall

Andricus punctatus Bass.

The rough, hard, woody, gnarled, scaly swellings produced by this gall-wasp (Fig. 58) on red oak limbs and twigs not over 1¼ inches in diameter are sometimes extremely abundant. The galls range in diameter from less than ½ to 1½ inches, depending on the size of the twig, are of variable length and frequently several coalesce to form an elongated mass of diseased tissue, which seriously interrupts the circulation of the sap. This gall-wasp frequently kills small branches, occasionally destroys larger limbs and is credited with seriously damaging good-sized trees.

Fig. 58.—Gouty oak gall.

Horned Oak Gall

Andricus cornigerus Osten Sacken

This is an irregular, rounded, woody gall (Fig. 59), ½ to 1½ inches in diameter and somewhat similar to the preceding except that the surface bears numerous horn-like protuberances through which the gall-flies escape. It occurs on the branches of pin, scrub and

Fig. 59.—Horned oak gall.

blackjack oak and is sometimes very common in the vicinity of New York City and farther south. It, like the preceding, kills branches and occasionally practically destroys entire trees.

Ribbed Bud-Gall

Andricus gemmarius Ashm.

The somewhat conical strongly ribbed galls of this species (Fig. 60) are about $\frac{3}{16}$ inch long and issue in crowded masses from longitudinal cracks in the bark. A sweetish secretion exudes from the galls in early summer and occasionally attracts hosts of bees and flies. A serious infestation may not only kill twigs but result in the death of trees.

Reference

1918, Felt, E. P., N. Y. State Mus. Bull. 202, pp. 63–65.

White Oak Club-Gall

Andricus clavula Osten Sacken

These subglobular, apical, woody twig-galls, $\frac{1}{2}$ to 1 inch long on white oak, are sometimes very common. These are very likely to result in the breaking of the twig at the injured point and when accompanied by the destruction of numerous buds, possibly by the alternate generation, serious injury may be caused.

Reference

1918, Felt, E. P., N. Y. State Mus. Bull. 202, p. 63.

Oak Fig Gall

Biorhiza forticornis Walsh

The galls produced by this insect (Fig. 61) are irregular, reddish-tinted, bladder-like growths which occur in dense clusters along the midrib of the leaves or upon the leaf-stems and small twigs of white and scrub oaks in midsummer. The

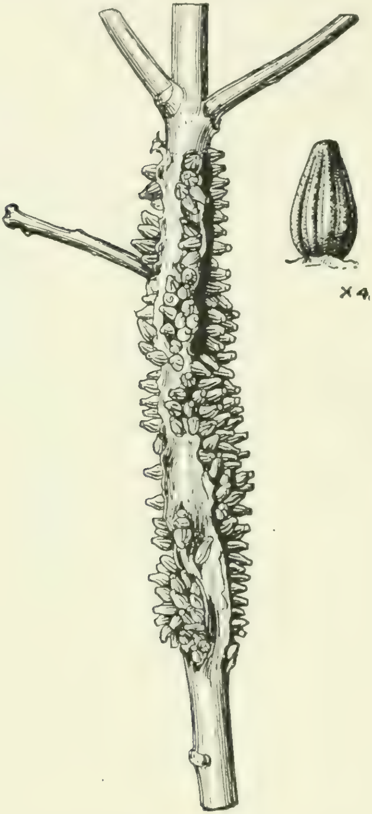

FIG. 60.—Ribbed bud-gall.


FIG. 61.—Oak fig gall.

galls vary in dimensions from 1/4 to 1/2 inch. The outer surface is covered with fine short hairs which soon become rubbed off from the more exposed portions.

Bullet-Galls

Disholcaspis spp.

There are a number of bullet-like galls (Fig. 62) having a diameter of approximately ½ inch which occur rather commonly upon various oaks, although as a rule they are not injurious.

Fig. 62.—Bullet-gall.

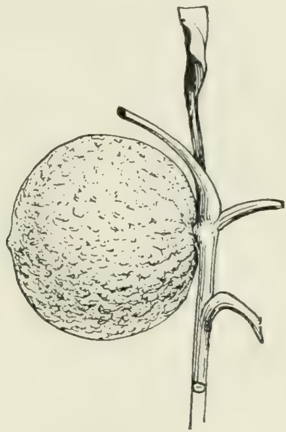

Fig. 63.—Oak apple.

Oak Apples

Amphibolips spp.

These peculiar somewhat globose galls (Fig. 63) may have a diameter of about 1½ inches, are greenish or brown, and contain a central larval cell surrounded by a spongy or filamentous mass. Occasionally these modifications of leaves are somewhat abundant, although they can hardly be considered as injurious.

Rose Galls

Rhodites spp.

A considerable series of deformities of the leaves, branches and roots are produced by gall-wasps belonging to this genus

Fig. 64.—Spiny rose gall.

Fig. 65.—Regal rose gall.

(Figs. 64, 65), one or two species occasionally becoming so abundant as to cause material damage.

Warty Oak Leaf-Gall

Cincticornia pilulæ Osten Sacken

The somewhat rounded hard woody galls of this species vary in size from approximately $1/8$ to $1/4$ inch and occur commonly on the leaves of pin, red, blackjack and scrub oak, being bright red or reddish-brown with reticulate markings, in August or September (Fig. 66).

Fig. 66.—Warty oak leaf-gall.

Birch-Seed Gall-Midge

Oligotrophus betulæ Winnertz

This European species, now well established in this country, develops in the seeds of birch, transforming them into greatly swollen empty capsules. The larvæ become full grown early in October.

Ocellate Maple Leaf-Gall

Cecidomyia ocellaris Osten Sacken

Red maple leaves are frequently thickly spotted with circular eye-like spots about 3/8 inch in diameter (Fig. 67), the disk being yellow and with the margin and central dot cherry-red. The depressed center of this peculiar marking is occupied by a nearly transparent fly-maggot, the adult of which is unknown, although this affection of the leaves is very common.

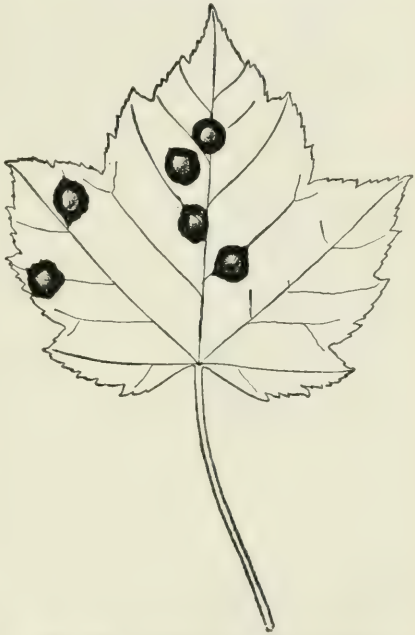

Fig. 67.—Ocellate maple leaf-gall.

Balsam Gall-Midge

Cecidomyia balsamicola Lintn.

The yellowish maggots of this small midge produce an oval enlargement near the base of balsam needles. The adult is unknown.

Willow Cone-Gall

Rhabdophaga strobiloides Walsh

The peculiar cone-like deformities about an inch long on the tips of willow shoots are produced by the larvæ of this midge (Fig. 68). Occasionally a large proportion of the shoots in one clump of willows is infested. The adult midges appear in April or early May and the gall attains full size by the middle of June.

Fig. 68.—Willow cone-gall.

Fig. 69.—Witch-hazel cone-gall.

Poplar Twig-Gall

Agromyza schineri Giraud

Greenish-yellow maggots of this fly occur in spongy oval masses on the sides of poplar twigs, the swellings ranging from about 3/8 inch in length to compound masses an inch long. The smaller galls contain only one larva, while the larger ones may be inhabited by several.

Witch-Hazel Cone-Gall

Hormaphis hamamelidis Fitch

Conical green or green and reddish-tipped galls about ½ inch long are sometimes very common on the upper surface of witch-hazel leaves (Fig. 69). The galls appear in the latitude of Washington about the middle of April, attaining full growth toward the end of May. This insect migrates to the foliage of birch, developing a number of generations thereupon. There is then a return migration, the insect wintering in the egg stage upon witch-hazel.

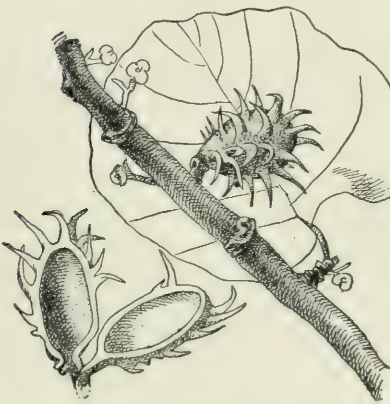

Fig. 70.—Spiny witch-hazel gall.

Fig. 71.—Poplar leaf-stem gall.

Spiny Witch-Hazel Gall

Hamamelistes spinosus Shimer

The many spined, green or reddish, somewhat oval galls, really bud deformations, about ¾ inch long, found on witch-hazel from June to the latter part of August, are produced by this plant-louse (Fig. 70), a species which likewise migrates to the foliage of birch and produces several different generations thereupon, one causing a corrugated or pseudo-galled condition of the leaves. The insect winters in the egg upon witch-hazel.

Vagabond Gall

Pemphigus vagabundus Walsh

Folded convolute masses of poplar leaves some two inches in diameter are somewhat common, the conspicuous, brownish or blackened, dried remains of these galls hanging on the trees over winter. The plant-lice issue in September and the green hollow galls develop the following summer.

Poplar Leaf-Stem Gall

Pemphigus populi-transversus Riley

This species produces oval somewhat elongated galls, with transverse openings near the middle of the leaf-petioles of cottonwood during the latter part of the summer (Fig. 71). The galls are nearly 1/2 inch in diameter and occasionally a very considerable proportion of the leaf-stems are thus deformed.

Grape Phylloxera

Phylloxera vitifoliæ Fitch

The numerous small wart-like leaf-galls (Fig. 72) about 1/8 inch long on the upper or lower surface of grape leaves are the work of this insect. The species is much better known because of its very injurious work on European grapes, due to the abundant production of irregular galls upon the roots and the consequent gradual dying of the affected vines. The galls of this insect occur commonly on wild grapes. It is a serious pest on European grapes in California and also in the wine-producing areas of Europe.

Reference

1915, Essig, E. O., Inj. Ben. Ins. Cal., pp. 72–73.

Hackberry Galls

Pachypsylla spp.

Several species of this genus (Fig. 73) develop on the hackberry and produce galls upon the twigs and leaves, these deformities occasionally being extremely abundant.

Fig. 72.—Grape phylloxera galls.

Fig. 73.—Hackberry bud-gall.

Bladder Maple Gall

Phyllocoptes quadripes Shimer

The small bladder-like galls about $\frac{1}{10}$ inch in diameter of this plant-mite (Fig. 74) are sometimes extremely abundant on the upper surface of the leaves of soft maple and cause a considerable deformation of the foliage and some disfiguration, since the galls are sometimes closely crowded and as they develop change from the normal leaf green to dull purple and finally dry up and blacken toward the end of the summer. Spraying in early spring with a lime-sulphur wash at winter strength appears to control this mite satisfactorily.

FIG. 74.—Bladder maple gall, a portion enlarged, one gall more enlarged.

COCKSCOMB ELM GALL

Colopha ulmicola Fitch

The leaves of American elms are sometimes seriously deformed by irregular, comb-like, greenish, red-tipped elevations between the leaf-veins (Fig. 75) and partly filled with struggling plant-lice and glistening globules of honey-dew. The young galls appear about the first of May as slightly elevated ridges on the upperside of the leaf. Usually there is only a sparse infestation. Very occasionally most of the leaves may be affected rather seriously and walks under infested trees

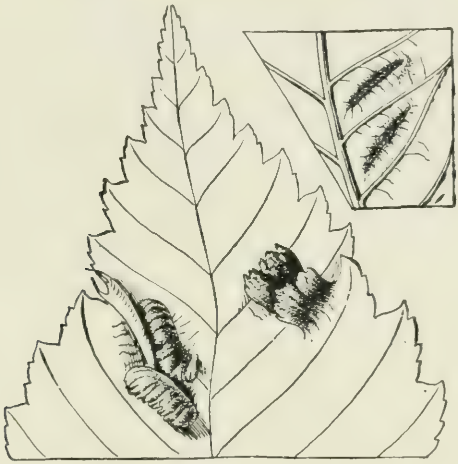

FIG. 75.—Cockscomb elm gall.

kept moist with the honey-dew. No practical remedial measures are known and usually treatment is unnecessary.

REFERENCES

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 186–187.
1910, Patch, E. M., Maine Agr. Exp. Sta. Bull. 181, pp. 196–208.

ASH FLOWER-GALL

Eriophyes fraxiniflora Felt

The staminate flowers of white ash are distorted by the work of this mite in such a manner as to produce series of irregular fringed, lobulated masses joined one to the other

(Fig. 76), each group ranging from 1/4 to about 3/4 inch in diameter and eventually drying and remaining on the trees

FIG. 76.—Ash flower-gall.

over winter. Winter applications of a miscible oil are reported as effective in preventing this unsightly development.

SPRUCE GALL-APHID

Chermes abietis Linn.

Cone-shaped many-celled green galls about 3/4 inch long and located at the base of young spruce shoots appear in June and later in the season turn brown, dry and crack open.

This European insect has become generally distributed in New York state and in some localities has seriously marred the appearance of Norway spruce, since the twig beyond the gall frequently dies and in bad infestations there is usually serious deformity (Fig. 77). The light yellow eggs are deposited from the second week in May to about the time spruces are putting forth new shoots and may then be enveloped in a white woolly mass in clusters of about 300 at the base of the buds. The eggs hatch in about a week and the young crawl to the tender shoots and establish themselves in cracks at the base of the leaves of young galls which have already begun to form. The infested buds develop in such a manner as to inclose the young gall-aphids in a series of chambers and when fully developed the growth presents a somewhat general resemblance to a minute pineapple. Early in August the galls lose their dark green color, turn yellowish, crack open and the winged plant-lice escape. Eggs laid by

FIG. 77.—Spruce cone-gall.

these latter hatch, and the young winter on the leaves or at the base of buds. The reader is also referred to the account of the spruce bud-scale, a frequently associated insect, see page 164.

Spraying thoroughly in April with a good contact insecticide, such as a standard miscible oil, diluted one to twenty, is a very effective control measure. A higher proportion of oil may result in foliage injury. On small trees it is possible to destroy most, if not all the insects, by cutting and burning the galls before they have turned yellow and begun to crack open. This should be done some time in July or even in June.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 189–191.

Sitka Spruce Gall

Gillettea cooleyi Gill.

This insect causes elongate twig galls, really swollen contiguous needle or leaf-bases, resembling very long Norway spruce galls some ½ to 3 inches long on Sitka spruce and the dying of the affected branches.

Fig. 78.—Sitka spruce gall.

This species (Fig. 78) is a serious enemy of the Sitka spruce in British Columbia, trees of all ages and varying in height from ten to over a hundred feet being heavily infested. The galls occur on the leading shoots of all the side branches and in many cases the entire shoot is destroyed. The entire twig may be affected or only a part, and if this be limited to one side there is marked deformation. The result is a steady weakening of the new growth and a pronounced reduction in the size of the galls. The life history is a complicated one, involving several host trees. This insect, better known as Chermes, lives also upon the Douglas fir (var. *coweni* Gill.) and western hemlock, about half of the insects on the Douglas fir developing wings in the spring and migrating to the Sitka spruce, the galls and the principal injury appearing on this latter tree.

REFERENCES

1916, Chrystal, R. N., Ent. Soc. Ont. 46th Rept., pp. 123–129.
1922, Chrystal, R. N., and Story, Fraser, Forestry Comm. (London), Bull. 4, pp. 1–50.

EUROPEAN WILLOW GALL-MIDGE

Rhabdophaga salicis Schrk.

This European insect has become well established in the central part of New York state. The distinct cane swellings (Fig. 79) inhabited by yellowish jumping maggots make the willows brittle and consequently unfit for binding purposes. The midges appear in early spring and presumably deposit their eggs in the developing buds, the galls resulting from the irritation produced by the numerous maggots as they develop in small groups. Nothing better in the way of control measures can be suggested than cutting and burning the infested shoots in early spring.

FIG. 79.—European willow gall.

REFERENCE

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 299–302.

HICKORY LEAF-GALLS

Phylloxera spp.

There are a considerable variety of globular, conical and other hickory leaf-galls produced by species belonging to this genus and easily recognized by the presence of minute wingless aphids or plant-lice within.

HICKORY GALL-APHID

Phylloxera caryæcaulis Fitch

Bullet-like hollow green galls of a leathery texture (Fig. 80) occur on hickory twigs or leaf-stems in June, turning black the latter part of the month or early in July and then somewhat resembling the black-knot of plum.

The galls of this species are more or less common every season and occasionally become extremely abundant with a corresponding amount of injury to the tree. The winter is probably passed in the egg stage, the initial attack presumably occurring on the leaf-stalk or young shoot as growth begins in the spring. The galls are globular in shape and range in size from that of a pea to an ounce ball. They are attached to the side of the stem and often cause a bend or distortion, especially when two or three are contiguous or confluent. The inside of the nearly developed gall is literally covered with minute shiny lice of different ages and at that time presents a marked resemblance to the geode of the mineral kingdom.

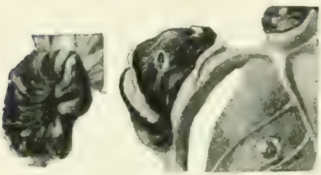

Fig. 80.—Hickory stem-gall.

Large series of hickory leaf-galls are produced by the genus Phylloxera and those interested should consult the admirable work by Pergande and the latter cited publication by the writer.

References

1904, Pergande, Theodore, Davenport. Acad. Sci. Proc. 9:185–283.
1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 331–352.
1918, Felt, E. P., N. Y. State Mus. Bull. 200, pp. 43–48.

CHAPTER VI

PLANT-LICE OR APHIDS

THE species belonging to this group, over 300, have much in common. They are small mostly delicate insects with somewhat pear-shaped bodies, long antennæ, four delicate wings with a few veins and usually near the posterior extremity of the body a pair of honey-tubes. Some species may be covered so thickly with a waxy secretion as entirely to conceal the insects. There are wingless as well as winged forms, although otherwise not differing in general appearance. Many species are greenish, some yellowish, a few bright red, others black and some present well-marked patterns of various colors. All are sucking insects and consequently are not affected by arsenical poisons.

Many species produce a number of generations in the course of a year and in not a few instances there is a marked alternation in food habits, as from birch to witch-hazel or alder to soft maple. Migration is preceded by the development of winged forms. Such changes are advantageous to the species since they enable these weak and defenseless forms to escape for a time at least from their natural enemies, such as lady beetles and their ugly black-spined grubs, the varicolored voracious maggots of flower-flies and the bloodthirsty aphis lions; all of which tend to become extremely abundant on badly infested plants and in not a few instances destroy most of the aphids. It is worthy of note that cool weather is favorable to some plant-lice, whereas moderately warm seasonable conditions are quickly followed by a great increase in the number of natural enemies and a speedy disappearance of the aphids.

The parthenogenetic reproduction in this group—that is, the development of a series of generations of wingless females only—appears to be one of nature's adaptations which enable plant-lice to maintain themselves in the face of tremendous odds; namely, a weak and defenseless condition and hordes of voracious enemies. The very short life cycle in the parthenogenetic generations, about a week, also aids greatly in offsetting the enormous losses inflicted by natural enemies.

The conditions outlined above result in enormous fluctuations in the aphid population of various trees and other plants and yet this group contains some of the most destructive insects. The green bug of the wheat fields of the Southwest, the hop aphid of the plum and hop yards, and the apple aphids of the orchards, are familiar examples of species which occasionally become excessively abundant and injurious. Aphids are known carriers of plant diseases, such as pear-blight and mosaic.

Plant-lice produce large quantities of honey-dew and in the case of badly infested trees it is not uncommon to see the foliage smeared with this exudation and blackened with a sooty fungus which quickly develops in this medium. The walks under trees are not infrequently kept moist with honey-dew even in hot, dry weather. This secretion is advantageous to the aphids since it attracts ants and they in turn give more or less efficient protection from other insects. Certain species produce an abundant woolly secretion which protects from natural agents. It is interesting to note in this connection that the caterpillars of a small butterfly habitually live under the woolly matter secreted by the alder blight aphis and frequently devour all of the aphids in such masses.

Generally speaking, plant-lice are easily controlled by thorough spraying with a contact insecticide, such as a tobacco soap preparation or an oil emulsion, provided the insects are actually hit. The woolly species are protected to some extent and in such cases it is necessary to use a coarse forcible spray which will penetrate the covering and come in contact with the insect beneath.

Key to Plant-Lice or Aphids

These are small mostly delicate insects with somewhat pear-shaped bodies, long antennæ, usually four delicate wings and near the extremity of the body a pair of honey-tubes.

Maples
- Somewhat large, rather hairy, greenish, brown-marked, on the underside of Norway maple leaves.
  - Norway maple aphid, *Chaitophorus lyropicta* Kess., p. 136.
- Small, red-eyed, black and white marked with wing-veins bordered with dark brown, on soft maple leaves.
  - Painted maple aphid, *Phymatosiphum acerifolii* Thos., p. 137.
- Conspicuous cottony masses on soft maple leaves from early spring to mid-July, also on alder.
  - Alder blight-aphid, *Prociphilus tessellatus* Fitch, p. 144.

Elm
- Inconspicuous green plant-louse on the underside of American elm leaves.
  - Elm leaf-aphid, *Callipterus ulmifolii* Mon., p. 137.
- Woolly aphids in badly curled leaves or upon wound tissue of the trunk and limbs.
  - Woolly elm aphids, *Schizoneura,* spp., p. 137.

Walnut
- Yellowish aphids on leaves.
  - Walnut aphid, *Chromaphis juglandicola* Kalt., p. 138.

Rose
- Greenish plant-lice clustering on the terminal shoots.
  - Rose aphids, *Macrosiphum rosæ* Linn., p. 139.
  - *Macrosiphum solanifolii* Ashm.
  - *Myzus rosarum* Kalt.

Birch
- Yellowish plant-lice on leaves in midsummer.
  - Birch aphid, *Euceraphis betulæcolens* Fitch, p. 141.

Beech
- Cottony masses on the underside of the leaves.
  - Woolly beech leaf-aphid, *Phyllaphis fagi* Linn., p. 140.

Viburnum
- Leaves badly curled and discolored.
  - Viburnum aphis, *Anuraphis viburnicola* Gill., p. 140.

Poplar

Aphids in folded cottonwood leaves.

Beet root-aphis, *Pemphigus betæ* Doane, p. 142.

Larch

Woolly aphids upon the leaves, suggesting a dusting with flour.

Woolly larch aphid, *Chermes strobilobius* Kalt., p. 139.

Arbor-vitæ

Brownish aphids on small twigs.

Arbor-vitæ aphid, *Lachnus thujafalinus* Del Guer, p. 142.

Pine, white

Patches of white flocculent downy material on the smooth bark of the trunk and underside of the limbs.

Pine bark-aphid, *Chermes pinicorticis* Fitch, p. 142.

Norway Maple Aphid

Chaitophorus lyropicta Kessler

This is the species commonly present on Norway maples in the northeastern United States. The rather large, hairy,

Fig. 81.—Norway maple aphid, portion of infested leaf and wingless female, latter enlarged.

greenish, brown-marked aphids occur on the underside of the leaves throughout the summer (Fig. 81). Sometimes the foliage is so seriously affected that all the leaves are badly wrinkled, blackened and only about two-thirds the normal size. In some cases this aphid appears to be responsible for a somewhat heavy leaf drop in midsummer. It is easily controlled with a tobacco soap spray.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 174–175.

Painted Maple Aphid

Phymatosiphum acerifolii Thos.

This species is very commonly present in scattering numbers on the leaves of soft maple. It is a small, red-eyed, black and white marked plant-louse with the wing-veins broadly margined with dark brown. Spraying for the control of this species is rarely necessary.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 175–176.

Elm Leaf-Aphid

Callipterus ulmifolii Monell

This is a common, inconspicuous, green plant-louse which is found occasionally in very large numbers upon American elms, the walks under infested trees being kept damp even in hot dry weather by the constantly dripping honey-dew. It is most likely to be numerous in midsummer.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 176–177.

Woolly Aphis of Apple and Elm

Schizoneura lanigera Hausm.

This insect is a well-known pest of apple trees, living upon the roots, the trunk the branches and even the water-sprouts. American elm leaves (Fig. 82) are frequently badly curled and twisted in June because of the abundant infestation by a woolly plant-louse, which recent investigations have shown to be identical with the woolly aphis of the orchard. In the case of bad infestations, the interior of the partly rolled leaf may be brimful of struggling plant-lice. The insects desert the leaves the last of June, consequently treatment for the elm curl is generally inadvisable. A closely related species,

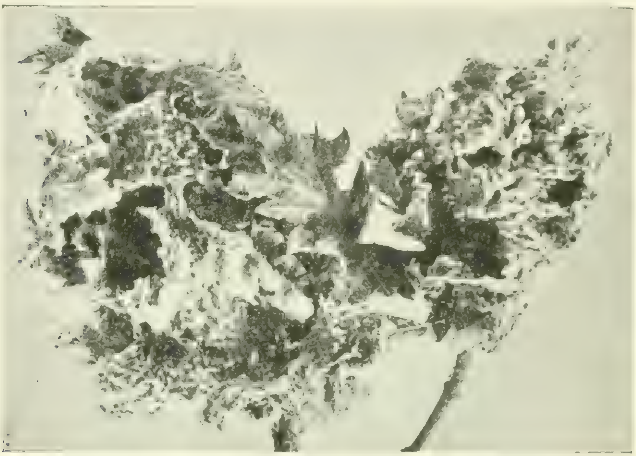

Fig. 82.—Elm leaves deformed by Schizoneura.

Schizoneura rileyi Thos., produces clusters of white woolly matter on knotted or wound tissue on the limbs and trunks of elms.

References

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 177–178, 192.
1912, Patch, E. M., Econ. Ent. Journ. 5:395–398.
1913, Patch, E. M., Maine Agr. Exp. Sta. Bull. 220, pp. 263–271.

Walnut Aphid

Chromaphis juglandicola Kalt.

Light yellow plant-lice with black markings on the antennæ, legs and abdomen may cause the smutting of walnut trees in

California during the early summer months. The winter is passed as eggs which hatch in February and March. Spraying with a commercial lime sulfur one to twenty between November and March kills the eggs. Summer applications of a 2 per cent distillate oil emulsion to which is added nicotine sulfate have given excellent results. A nicotine dust has been used very successfully.

References

1915, Essig, E. O., Inj. Ben. Ins. Cal., pp. 82–83; also 1921, Econ. Ent. Journ. 14:392–393.

Woolly Larch Aphid

Chermes strobilobius Kalt.

Fig. 83.—Woolly larch aphid, eggs at base of whorl of leaves, young in woolly matter on leaf and young more enlarged.

Larches badly infested by this insect appear as though they had been lightly dusted with flour or very small particles of woolly matter. The insect (Fig. 83) winters as masses of eggs at the base of the leaves, the young hatching in May and developing a conspicuous woolly excretion in June. The life history is complicated.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 187–188.

Rose Aphids

Macrosiphum rosæ Linn.

This greenish plant-louse occurs commonly on roses, clustering on the terminal shoots and frequently causing serious injury. A similar species, *Myzus rosarum* Kalt., also occurs upon the terminal shoots, both being practically limited to the rose. A third species, *Macrosiphum solanifolii* Ashm., better known as the pink and green potato aphis on account of the serious injury to that crop by summer generations, has the rose as the one primary host upon which it normally winters, although it occurs in summer on a great variety of plants. Aphid infestations are easily controlled by early and thorough spraying with a tobacco soap preparation.

References

1912, Davis, J. J., State Ent. Ill. 27th Rept., p. 117.
1914, Patch, E. M., Maine Agr. Exp. Sta. Bull. 233, pp. 268–269, and Bull. 303, 1921, pp. 321–344.

Viburnum Aphis

Anuraphis viburnicola Gill.

The leaves of the common snowball or viburnum are frequently badly curled or deformed by an ashy-gray or dark-greenish aphid and discolored by sooty fungus growing in the abundant honey-dew. The young appear with the leaves and desert the host in June. Bud spraying with a tobacco soap preparation before there is serious injury is the most effective treatment.

Reference

1909, Gillette, C. P., Ent. News, 20: 280–285.

Woolly Beech Leaf-Aphid

Phyllaphis fagi Linn.

The cottony masses somewhat common on the underside of beech leaves usually shelter young of this somewhat common plant louse (Fig. 84). They are pale greenish-yellow, usually with a few scattering, bluish-white filaments at the posterior extremity. The aphids frequently nestle among the leaf-hairs. Thorough spraying with a tobacco soap preparation is the most effective control measure.

Fig. 84.—Woolly beech leaf-aphid, infested leaf, adult enlarged.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 601–602.

Birch Aphid

Euceraphis betulæcolens Fitch

This delicate yellowish plant-louse is sometimes very injurious to birches in midsummer in the northeastern United

States, particularly the ornamental cut-leaved variety. Early and thorough spraying with a tobacco soap preparation is one of the best control measures.

REFERENCE

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, p. 601.

BEET ROOT-APHIS

Pemphigus betæ Doane

The young of this species hatch from winter eggs deposited upon the twigs and attack the developing leaves, causing them to fold. The next generation migrates to the fields and is there known as a serious pest of beets.

REFERENCE

1915, Essig, E. O., Inj. Ben. Ins. Cal., pp. 75–76.

ARBOR-VITÆ APHID

Lachnus thujafalinus Del Guer.

The hairy amber-brown aphids about 1/8 inch long and with the upper surface partly covered with a whitish powder feed in clusters upon the bark of the branches of arbor-vitæ and are probably responsible for unexplained weakness of smaller branches. The insects appear to be widely distributed and presumably can be controlled by thorough forcible applications of a contact insecticide.

REFERENCE

1915, Essig, E. O., Inj. Ben. Ins. Cal., p. 80.

PINE BARK-APHID

Chermes pinicorticis Fitch

Patches of white, flocculent, downy material on the smooth bark of the trunk and undersides of the limbs of white pine and balsam are usually caused by this insect (Fig. 85). These white patches are really colonies of dark brown plant-lice covered with an abundant woolly secretion. They are frequently so numerous, especially in parks, as seriously to reduce the vitality of the trees. The infestation may result in a sickly condition, terminating in a few years with the death of the pines.

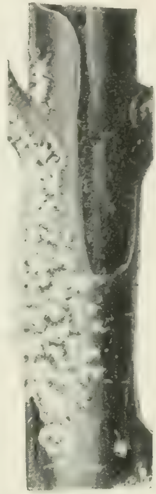

FIG. 85.—Pine bark-aphid; the white woolly matter is characteristic.

The insect winters as eggs deposited in downy balls near the bases of the leaves, each containing from five to sixty or more. The eggs hatch early in May and the young crawl actively for a time and then establish themselves on the tender bark of the young growth, increase rapidly in size, becoming dark reddish-brown, approaching black, and the cottony secretion soon hides them from view. Maturity is attained toward the end of May and eggs deposited for another brood. There are several generations each season.

When a good head of city water is available, it is easy to wash these masses of woolly aphids from the trees by the judicious use of a somewhat powerful stream. Whale-oil soap used in May at the rate of one pound to four gallons of water has given good results with some, provided the spray was coarse and applied with force. Spraying with a tobacco preparation to which soap or a spreader, such as casein, has been added, is one of the later more promising control measures, since it can be applied during the summer and treatments repeated within a week or ten days of each other, thus killing many of the issuing young. In all cases, it is necessary to use a somewhat coarse forcible spray in order to drive the insecticide through the protective woolly matter so as to bring it into contact with the insects underneath.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 187–188.

Alder Blight-Aphid

Prociphilus tessellatus Fitch

Conspicuous cottony masses on the underside of alder stems and similar masses on soft maple leaves from early spring to mid-July conceal plant-lice belonging to this species (Fig. 86).

Fig. 86.—Alder blight-aphid, adults and young.

The alder blight is well known to all familiar with the Adirondacks. Only recently has the identity of this insect and the woolly aphid occurring on soft maples been established. The alder-inhabiting form is further noteworthy because the caterpillar of the little orange butterfly, *Feniseca tarquinius* Fabr., works under the woolly masses and preys on the plant-lice. The migration from the alder to soft maple occurs in the fall, the migrants then producing true, apterous males and females, the latter depositing eggs upon the bark from which the maple leaf-inhabiting forms develop the following spring. The insect also winters upon the alder, the hardy hibernating generation ascending from leaf-protected retreats on the base of the alders and establishing themselves in early spring on the alder tips.

Ornamental alders can be protected simply by washing the insects off with a forcible spray or the application of a contact insecticide driven through the woolly covering so that it will come into contact with the insect beneath. The soft maple form ordinarily will desert the trees shortly after the infestation is discovered and as a rule remedial measures would hardly be advisable.

References

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 195–196.
1909, Patch, E. M., Econ. Ent. Journ. 2:35–36.

CHAPTER VII

SCALE INSECTS

Some of the most important enemies of trees are among scale insects. The recently introduced San José scale has been noteworthy in this respect, having killed thousands of trees of various kinds, although its depredations in fruit orchards have naturally attracted the most attention. There is a very large series, some 2,000 species, of scale insects. They are closely related to their food plants, there being, as a rule, only a very limited period of activity, and as a consequence of this close association scale insects have become widely disseminated through the extensive distribution of both ornamental and fruit-trees. Many scale insects are quite restricted in food habits, while others thrive to a greater or less extent on a considerable variety of plants and when those belonging to this latter class are very prolific, serious injury is likely to result. The American species fall readily into three groups; namely, the mealy-bugs, the soft scales and the armored scales. The first are represented by the common mealy-bugs of the greenhouse, the second by the numerous hemispheric brown scales occurring on various plants, such as the tulip soft scale, and the third by the familiar oyster-shell scale and the scurfy scale of the orchard. These last are distinguished from the others by the waxy scale, really a matting down of a waxy secretion, which begins to form as soon as the scale insect establishes itself upon the plant and the adherent exuviæ, and soon come to resemble closely indeed the surface to which they are attached. Once established upon the bark, the armored scales are unable to move, although they produce free-crawling young. Most scale insects are small in size. The largest native species, the magnolia scale, has a diameter of approximately half an inch. The soft and the armored scales are the forms ordinarily injurious to trees. The former are usually controlled by early spring applications of a miscible oil, care being exercised not to apply too concentrated a solution or too much, and the latter are generally checked very effectually by winter or early spring applications of a lime-sulfur wash, winter strength. There is also an opportunity of destroying armored scales by spraying during the growing season and at a time when the delicate young are active and therefore not protected from caustic or deadly applications.

Key to Scale Insects

These are all small, rarely 1/4 inch in diameter, usually oval or circular and generally covered with a scale, hence the common name, although sometimes protected by woolly excretions. They occur on the leaves and bark, mostly the latter.

Elms and other trees

Brownish, oyster shell-like scales about 1/8 inch long, on twigs, more abundant on ash, poplar and balm of Gilead.

Oyster-shell scale, *Lepidosaphes ulmi* Linn., p. 149.

Irregularly oval whitish scales about 1/10 inch long, on twigs, especially abundant on Japanese quince. This and related species occur on a variety of trees.

Scurfy scale, *Chionaspis furfura* Fitch, p. 152.

Circular, blackish, grayish, or yellowish-gray scales about 1/16 inch in diameter, abundant on Japanese quince and on a large variety of trees and shrubs.

San José scale, *Aspidiotus perniciosus* Comst., p. 149.

A somewhat larger scale with brick red in place of yellowish, less abundant than the San José scale.

Putnam's scale, *Aspidiotus ancylus* Putn., p. 150.

A circular dark-brown scale, diameter 1/10 inch, southern, occurs on a great variety of trees.

Camphor scale, *Pseudaonidia duplex* Ckll., p. 163.

Reddish woolly bordered bark-louse about 1/10 inch long, on bark; the yellowish young on leaves in midsummer, on elms only.

Elm bark-louse, *Gossyparia spuria* Mod., p. 161.

Amber to reddish-brown scale about 1/8 inch in diameter.
European fruit lecanium, *Eulecanium corni* Bouché, p. 155.

Maple
Cottony masses protruding from a brown scale, on sugar maple leaves.
Maple leaf-scale, *Pulvinaria acericola* Walsh and Riley, p. 159.
Cottony masses on sugar maple leaves, showing no brown scales, or a chalky appearance on the trunk.
Maple phenacoccus, *Phenacoccus acericola* King, p. 159.
Cottony masses protruding from under a brown scale and extremely abundant upon the twigs, especially soft maple.
Cottony maple scale, *Pulvinaria vitis* Linn., p. 158.
Hemispheric, reddish, black-marked scales 1/8 to 1/6 inch in diameter, on twigs of sugar and soft maple.
Black-banded scale, *Eulecanium nigrofasciatum* Perg., p. 154.

Tulip tree
Hemispherical brown twig-scales nearly 1/4 inch in diameter.
Tulip tree scale, *Toumeyella liriodendri* Gmel., p. 156.

Magnolia
A large, hemispherical, brown twig-scale about 1/2 inch in diameter.
Magnolia scale, *Neolecanium cornuparvum* Thrs., p. 157.

Euonymus
Brownish oyster shell-like scales and whitish ridged male scales, both on the bark, also on bittersweet.
Euonymus scale, *Chionaspis euonymi* Comst., p. 153.

Rose
A whitish scurfy scale on rose canes.
Rose scale, *Aulacaspis rosæ* Bouché, p. 154.

Oak
Circular dark gray scales about 1/10 inch in diameter, occurs on a number of trees.
Obscure scale, *Chrysomphalus obscurus* Comst., p. 151.
Golden scale about 1/16 inch in diameter, occurring in pits or depressions of the bark.
Golden oak scale, *Asterolecanium variolosum* Ratz., p. 157.

Walnut
Circular, light grayish scale, diameter 1/8 inch.
Walnut scale, *Aspidiotus juglans-regiæ* Comst., p. 151.

Azalea
A woolly oval scale 1/8 inch long.
Azalea bark-scale, *Eriococcus azaleæ* Comst., p. 163.

Juniper
A circular snowy-white scale, diameter 1/20 inch, on leaves.
Juniper scale, *Diaspis carueli* Targ., p. 153.

Pine
White-specked needles.
Pine leaf-scale, *Chionaspis pinifoliæ* Fitch, p. 152.
Oval, dark gray, often blackish leaf-scales, diameter 1/10 inch, occurs also on hemlock, fir and maple.
Hemlock scale, *Aspidiotus abietis* Schr., p. 151.
Woolly scales on the tender growth of pitch pine.
Woolly pine scale, *Pseudophilippia quaintancii* Ckll., p. 162.
Spruce
Subglobose chestnut-brown scales on small dying twigs.
Spruce bud-scale, *Physokermes piceæ* Schr., p. 164.

Oyster-Shell Scale

Lepidosaphes ulmi Linn.

The brownish oyster shell-like scale (Fig. 87) about 1/8 inch long of this species is rather common on a considerable variety of trees and shrubs, being particularly abundant on ash, poplar and balm of Gilead. The dying of small elm branches is frequently caused by this or a closely related insect. The winter is passed as delicate whitish eggs under the female scales, the minute yellowish young appearing from the middle of May to early June. Early spring applications of a lime-sulfur wash at winter strength or a miscible oil, one to fifteen, have proven very effective. It is also possible to check this pest by applying a tobacco soap preparation at the time the young are crawling.

Fig. 87.—Oyster-shell scale, young and full grown, one showing circular hole made by a parasite, greatly enlarged.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 211–213.

San José Scale

Aspidiotus perniciosus Comst.

This is a circular grayish or yellowish scale insect about 1/16 inch in diameter (Fig. 88). It is notorious on account of the enormous losses caused in earlier years and has been an important factor in bringing about the development of comprehensive quarantine regulations in this country. The female scale is frequently surrounded by large numbers of much smaller nearly black scales having a central nipple and one or two grayish rings. This insect winters in a partly grown condition, the young appearing in the latitude of New York toward the last of June. There are probably three generations annually, with a fourth developing under exceptionally favorable conditions. This pest occurs upon a very large number of trees and shrubs, thriving best on apple, pear and Japanese quince.

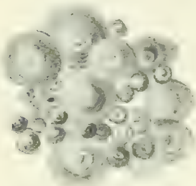

Fig. 88.—San José scale, young and full grown, greatly enlarged.

Natural enemies have controlled the San José scale to a considerable extent in various localities during recent years. Thorough spraying in early spring with a lime-sulfur wash at winter strength has proved effective, although some prefer a miscible oil, one to fifteen.

Reference

1905. Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 216–226.

Putnam's Scale

Aspidiotus ancylus Putn.

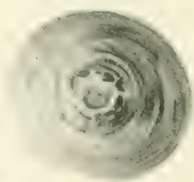

Fig. 89.—Putnam's scale, greatly enlarged.

This resembles the preceding species rather closely, except that it is somewhat larger and the nearly central exuvium in this scale is brick-red rather than yellowish. This species (Fig. 89) is rarely abundant enough to cause material injury and when numerous can be controlled in the same way as the San José scale.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 226–227.

Walnut Scale

Aspidiotus juglans-regiæ Comst.

The life history of this light gray scale insect, some ⅛ inch in diameter, is practically the same as that of the San José scale. It is very injurious to English walnut in California, killing large branches or even entire trees. The control is the same as for the San José scale.

Reference

1915, Essig, E. O., Inj. Ben. Ins. Cal., pp. 177–179.

Obscure Scale

Chrysomphalus obscurus Comst.

This is a small, circular, easily overlooked, dark-gray scale about $\frac{1}{10}$ inch long, occurring on oaks and a number of other trees. It frequently causes the death of twigs, limbs and branches and sometimes of the entire tree. It is somewhat southern in habit and, like the preceding pest, passes the winter in a partly grown condition. Applications of lime sulfur or a miscible oil at winter strength are the control measures advised.

Reference

1918, Houser, J. S., Ohio Agr. Exp. Sta. Bull. 332, pp. 284–285.

Hemlock Scale

Aspidiotus abietis Schr.

This is an oval, dark gray, often blackish scale with a lighter margin, a length of about $\frac{1}{10}$ inch and sometimes with a bluish, brownish or purplish tinge. It occurs on hemlock, pine, fir and has been recorded from maple.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, p. 690.

Scurfy Scale

Chionaspis furfura Fitch

A bad infestation by this insect gives the trunks and limbs a whitish scurfy appearance (Fig. 90). The whitish female scale is irregularly oval, with a yellowish point and about $\frac{1}{10}$ inch long. The male scale is elongate and tricarinate. The purplish-red eggs may be found under the scales during the winter, the young appearing from the middle to the last of May. This insect has a special fondness for Japanese quince, although it is known to occur on a considerable variety of plants. Lime-sulfur washes or miscible oils, one to fifteen, have proven very effective in controlling this insect.

Fig. 90.—Scurfy scale, females and males, latter long and narrow, greatly enlarged.

Scurfy scales similar to the preceding occur on elm and dogwood. The former is *Chionaspis americana* Johns and the latter *C. corni* Cooley. Their habits are practically the same and the control measures identical with those recommended for the scurfy scale.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 214–216.

Pine Leaf-Scale

Chionaspis pinifoliæ Fitch

Needles of various pines sometimes bear snowy-white specks and occasionally are so abundantly infested as to suggest a dusting with starch. Purplish eggs may be found under the scales during the winter, the young appearing in May and those of a second generation some time in July. This insect is very common in California. Spraying with a miscible oil, one to sixteen or twenty in early spring before the foliage starts, has given very satisfactory results. The extended breeding season makes summer spraying inadvisable.

References

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 229–231.
1918, Houser, J. S., Ohio Agr. Exp. Sta. Bull. 332, pp. 291–293.

Euonymus Scale

Chionaspis euonymi Comst.

This insect (Fig. 91) is limited to various species of Euonymus and bittersweet. The female resembles the oyster-shell scale, while that of the male is ridged and white. The winter is passed in the egg stage and there are at least two generations each season. This is a greenhouse species in California. A miscible oil, one to fifteen, applied in early spring has given excellent results.

Fig. 91.—Euonymus scale, males and females, greatly enlarged.

References

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 213–214.
1918, Houser, J. S., Ohio Agr. Exp. Sta. Bull. 332, pp. 293–294.

Juniper Scale

Diaspis carueli Targ.

This is a circular, snowy-white, widely distributed scale about $\frac{1}{20}$ inch in diameter which is occasionally somewhat abundant and injurious on juniper leaves. The winter is passed in a nearly full-grown condition, the young appearing early in June. Spraying with a miscible oil, one to twenty, in early spring has given very good results.

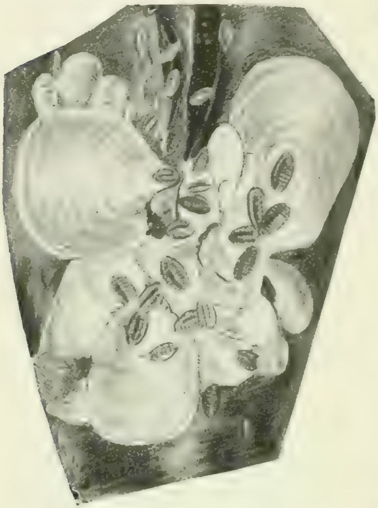

Fig. 92.—Rose scale, greatly enlarged.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, p. 229.

Rose Scale

Aulacaspis rosæ Bouché

A whitish scurfy appearance on the canes of roses usually means an infestation by this widely distributed insect (Fig. 92). Purplish eggs may be found under the scales during the winter, the young appearing the latter part of May or early in June. All stages occur practically throughout the year in California. Badly infested canes should be cut and burned and others sprayed in early spring with a lime-sulphur wash, winter strength, or a miscible oil, one to sixteen.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, p. 228.

Black-Banded Scale

Eulecanium nigrofasciatum Perg.

A small, hemispheric, reddish, black-marked scale insect with dimensions of $\frac{1}{8}$ to $\frac{1}{6}$ inch (Fig. 93) is sometimes extremely abundant and somewhat injurious to maples, both sugar and soft. It also attacks a variety of other trees, such as plum, apple, pear, quince and in Ohio is reported as being injurious to sycamore. The crawling young appear from about the middle of June till the middle of July, establishing themselves first on the greener shoots near the base of the leaves. The partly grown females winter, development being completed the following spring. Badly infested twigs have a sour semi-putrid odor which is somewhat characteristic of the species. Early spring applications of a miscible oil are advisable except on sugar maple, where it is safer to limit treatment to tobacco soap preparations, applied when the young are crawling in large numbers.

Fig. 93.—Black-banded scale, infested twig, females and male much enlarged.

References

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 200–203.
1918, Houser, J. S., Ohio Agr. Exp. Sta. Bull. 332, pp. 299–301.

European Fruit Lecanium

Eulecanium corni Bouché

An amber to dark reddish-brown very convex scale about ⅛ inch in diameter occurs on elms and a variety of trees and shrubs over a great part of the United States. The winter is passed in a partly grown condition, the small yellowish young appearing in April and May in California and in May or June in New York state. Winter applications of a miscible oil are best for this insect and related forms, provided there is no danger of injuring the host tree.

Reference

1915, Essig, E. O., Inj. Ben. Ins. Cal., pp. 146–148.

Tulip Tree Scale

Toumeyella liriodendri Gmel.

The large hemispherical brown scales of this insect (Fig. 94), nearly 1/4 inch in diameter, are conspicuous objects on the underside of tulip tree branches in midsummer. It has, like the black-banded scale, a somewhat unpleasant odor. The winter is passed as small inconspicuous partly grown scale insects. The young appear late in August. Spraying in

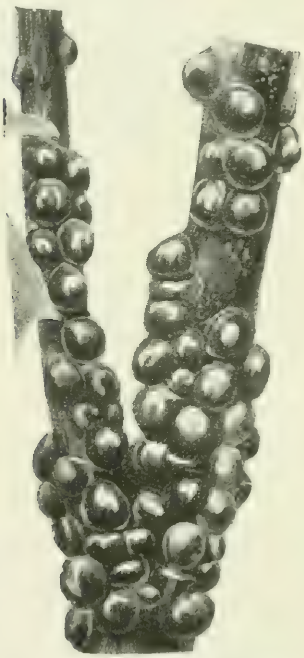

Fig. 94.—Tulip tree scale, badly infested twig.

Fig. 95.—Golden oak scale, infested twig.

early spring with a miscible oil, one to fifteen, has given excellent results. Britton advises lime-sulfur, winter strength, just after the leaves fall, since under certain conditions there is danger of oil injury.

References

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 208–210.
1918, Houser, J. S., Ohio Agr. Exp. Sta. Bull. 332, pp. 301–302.
1921, Britton, W. E., 21st Rept. State Ent. Conn., pp. 176–178.

Magnolia Scale

Neolecanium cornuparvum Thrs.

This scale is larger than the preceding, measuring about ½ inch in diameter. The young are produced in late July or early August. The habits of the insect and methods of control are practically as in the preceding.

Reference

1918, Houser, J. S., Ohio Agr. Exp. Sta. Bull. 332, pp. 302–303.

Golden Oak Scale

Asterolecanium variolosum Ratz.

This golden, pit-making scale insect, about $\frac{1}{16}$ inch in diameter (Fig. 95), is sometimes very abundant on oak twigs and branches and is recorded as one of the most destructive scale insects of oaks. Large trees as well as small ones may be killed outright. The young begin to appear in May, the insect evidently wintering in a full grown or nearly full grown condition. This pest is noteworthy because of the well-marked pits in the bark, evidently caused by the bark tissues under and in the near vicinity of the scale failing to develop normally. It is probably widely distributed. Spraying in early spring with a miscible oil, one to fifteen, has given excellent results.

References

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 329–331.
1918, Houser, J. S., Ohio Agr. Exp. Sta. Bull. 332, pp. 306–308.

Cottony Maple Scale

Pulvinaria vitis Linn.

This is by far the most common and injurious of the cottony maple scales (Fig. 96). It occurs on a considerable variety of plants, thrives best on soft maple and to a less extent on hard maple. The maple scale is mainly a twig, rather than a leaf insect, and in early summer it is not unusual in the vicinity of New York City to see the smaller twigs of soft maples fairly festooned with bunches of cottony matter projecting from closely placed oval brown scales nearly 1/4 inch in diameter, the entire mass, scale and cottony material, frequently with a major dimension of 1/2 inch. The eggs are laid, occasionally to the number of 500, in the cottony mass, some time in June, the young in New York state crawling in immense numbers the latter part of July. The breeding season at Washington extends from the latter part of May or early June into July and may last till August. The safest control measure on hard maple is to apply a tobacco soap preparation when about one-half of the eggs have hatched, making a second application about ten days later. Soft maples are not equally susceptible to oil, and early spring applications of an oil emulsion, one to fifteen parts of water, have given excellent results. Kerosene and carbolic acid emulsions or a resin wash when the young are hatching are recommended in California.

Fig. 96.—Cottony maple scale, infested twig.

References

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 196–200.
1918, Houser, J. S., Ohio Agr. Exp. Sta. Bull. 332, pp. 295–297.

Maple Leaf-Scale

Pulvinaria acericola Walsh and Riley

This insect (Fig. 97) produces considerable cottony matter and easily may be mistaken for the cottony maple scale, a much more common and injurious species. This leaf insect occurs on the sugar maple and is easily recognized by the

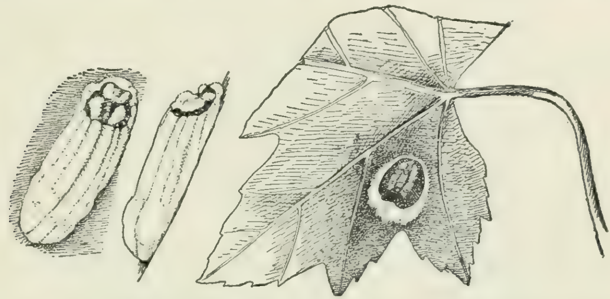

Fig. 97.—Maple leaf-scale, full grown on leaf, with fully developed egg sac on left.

cottony masses protruding from under the ovate brownish scales. The eggs hatch the latter part of May or in June, the young establishing themselves upon the leaves and developing gradually until October, at which time migration occurs to the trunk, where hibernation takes place. The insects become active again in the spring, the females migrating to the leaves and depositing eggs. It appears to be a southern species and occurs rarely in New York state.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 179–182.

Maple Phenacoccus

Phenacoccus acericola King

The cottony masses sheltering females of this species (Fig. 98) are frequently very abundant in midsummer on the under surface of sugar maple leaves. The full-grown males migrate to the trunk and settle in such large numbers as to give a characteristic chalky appearance to badly infested trees. There are three generations, the second brood hatching in June, the third in August, the young of the last over-wintering.

The sugar maple is so sensitive to oil applications that such treatments can not be advised. Thorough and usually re-

Fig. 98.—Maple phenacoccus, young and females on leaf, males on bark.

peated spraying at one or more weekly intervals with a tobacco soap preparation at the time the minute yellowish young are crawling is the safest and on the whole the most satisfactory method of control.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 182–186

Elm Bark-Louse

Gossyparia spuria Modeer

This soft scale (Fig. 99), a recent introduction, has become well established in the United States. It was extremely abundant and injurious about 1900, and in later years there has been a perceptible reduction in its numbers, presumably as a result of the activity of various natural agents. The underside of elm limbs may be crowded thickly in summer with reddish woolly-bordered bark-lice about $\frac{1}{10}$ inch long

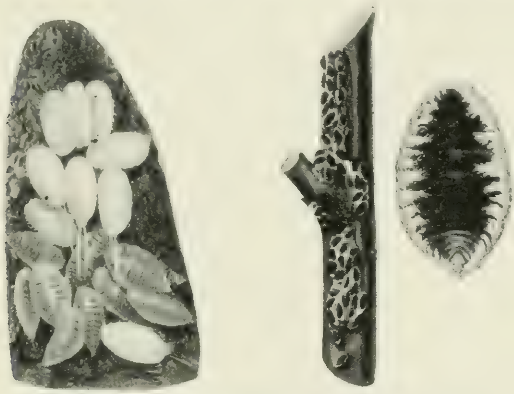

Fig. 99.—Elm bark-louse, infested twig, young and male cocoons on left, fully developed female on right, two latter greatly enlarged.

and, if the infestation is severe, walks beneath the infested trees are frequently moistened with the excreted honey-dew. The winter is passed in a partly grown condition, the minute yellowish young appearing in early July, establishing themselves upon the leaves and leaf-stems and later migrating to the twigs and branches. This insect has been widely distributed with nursery stock, and in cities it is unquestionably carried from tree to tree by birds.

Early spring applications of a miscible oil, one to fifteen, have given excellent results. Where a good head of water is convenient, many of the insects may be dislodged by a forcible spray in early spring.

References

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 203–207.
1918, Houser, J. S., Ohio Agr. Exp. Sta. Bull. 332, pp. 303–305.

Woolly Pine Scale

Pseudophilippia quaintancii Ckll.

A conspicuous snow-white woolly scale on the more tender growth of pitch pine is suggestive of spittle insect infestation, though it is really a scale insect. This is known locally as "bleeding pitch" and "pitch pine wool." The twigs turn brown and become purple soon after the scales drop off. A black fungus develops in the excreted honey-dew.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 689–690.

Cypress Bark-Scale

Ehrhornia cupressi Ehr.

The Monterey cypress frequently is badly infested with this woolly bark-louse. A limb or two of an infested cypress may turn yellow, then red or brown and give the tree a scraggy appearance. This often starts near the top of the tree and works down toward the center or perhaps spreads from one limb to the others until the entire tree is dead. Yellow and red spots may appear in cypress hedges and these finally increase to large proportions, leaving wide gaps dead. The insect infests a large percentage of these trees in California and causes much injury, particularly in thickly planted hedgerows. It winters as a full-grown female. The deposition of eggs begins in the spring and lasts throughout the summer.

This species affects not only the Monterey cypress but the Arizona and Guadalupe cypress and incense-cedar, the last probably the original host.

Spraying twice, once in August and once the latter part of September, with a miscible oil emulsion, one to seven, has given very satisfactory control.

Reference

1920, Herbert, F. B., U. S. Dept. Agr. Bull. 838, pp. 1–22.

Azalea Bark-Scale

Eriococcus azaleæ Comst.

This native species has invaded greenhouses and within recent years has been very troublesome to azaleas in the western part of New York state. It is most easily recognized as an oval cottony deposit upon the twigs, each insect being about ⅛ inch long. The scale appears to multiply very rapidly under cool conditions. Laying the potted plants on boards outside the greenhouse and literally washing off the scale insects with a forcible stream of water checks the pest very effectively.

Camphor Scale

Pseudaonidia duplex Ckll.

A circular, moderately convex, dark blackish-brown scale insect about $\frac{1}{10}$ inch long and with large, round, orange-colored exuviæ nearly to one side occurs upon the bark of many trees and shrubs in some southern states.

This Japanese scale insect was first brought to notice in 1896 in a Japanese nursery in San Francisco. It has recently become established in Louisiana, and several infestations, reported as having been eradicated, have been recorded from Mississippi. This scale proved very injurious in Louisiana to a large number of trees and shrubs, such as camphor, fig, rose, hackberry, elm, citrus and others, the list of known hosts including 172 species of plants. The toxic effect is very marked. Only a few scales on a twig are sufficient to cause defoliation. Trees have been killed within six months after attack. Little is known concerning the biology of this pest. The females deposit about 200 eggs over a period of approximately a month, the scales settling within a few hours after hatching, the males on the leaves and the females on the twigs. The over-wintering female scale is remarkable on account of its unusually large size as compared with the summer form. It is believed that ants are a factor in promoting infestation.

Defoliation by pruning out all branches and limbs which have leaves and spraying with a 2 per cent emulsion consisting of fish-oil, potash soap and junior red engine oil (a Standard Oil product), has been found to give 100 per cent control. Fumigation with hydrocyanic acid gas has given excellent results in California.

References

1896, Cockerell, T. D. A., Psyche, vol. 7, Supplement, p. 20.
1896, Craw, Alexander, Cal. State Bd. Hort., 5th Bien. Rept., pp. 33–34.
1922, Barber, E. R., Econ. Ent. Journ. 15:105–106.

Spruce Bud-Scale

Physokermes piceæ Schr.

Weakened or dying tips of Norway spruce branches apparently suffering from no particular insect or disease may have been killed by this scale insect (Fig. 100).

This peculiar pest establishes itself at the base of the branchlets, there sometimes being clusters of two to five or even six of the oval chestnut-brown scales on a twig having a diameter of less than 1/8 inch. Each of these insects very closely resembles a somewhat abnormally developed bud, hence the common name, and is easily mistaken for such. Occasionally this scale becomes so very abundant and secretes so much honey-dew in May and June as to attract swarms of bees. The tender young scales issue the latter part of July. This pest frequently occurs on trees infested by the spruce gall-aphid, *Chermes abietis* Linn., and this latter insect credited with causing all the injury, although cases of severe damage follow infestation by this scale insect. A related species, *P. insignicola* Craw, occurs on the Monterey and other pines and fir in California.

Fig. 100.—Spruce bud-scale; note resemblance to buds, enlarged.

Spraying in early spring with a miscible oil diluted one to twenty is one of the most promising methods of controlling this pest. It can also be checked to a considerable extent at least by applications of a tobacco soap preparation, in the latter part of July, at the time the tender young are active.

References

1909, Gates, B. N., Econ. Ent. Journ. 2:466.
1915, Felt, E. P., N. Y. State Mus. Bull. 180, pp. 85–86.

CHAPTER VIII

OTHER SUCKING INSECTS INJURIOUS TO ORNAMENTAL TREES

THIS division merely includes those species of sucking insects which can not be placed in any one of the previous easily recognized natural groups.

KEY TO OTHER SUCKING INSECTS

Box elder
A moderately stout, blackish, red-marked bug about ½ inch long on trunks and branches in late summer.
Box elder plant-bug, *Leptocoris trivittatus* Say, p. 167.

Maple, Norway
Badly swollen apparently cankerous twigs and leaves with numerous yellowish hoppers.
Norway maple leaf-hopper, *Alebra albostriella* Fall., p. 167.

Rose
Minute white spots on the leaves and numerous whitish jumping insects.
Rose leaf-hopper, *Empoa rosæ* Harr., p. 168.

Rhododendron
Yellowish or brown-spotted foliage.
Rhododendron lace-bug, *Stephanitis rhododendri* Horv., p. 169.

Azalea
Discolored foliage, in severe cases the leaves are almost white.
Azalea lace-bug, *Stephanitis pyrioides* Scott, p. 170.

California Christmas-berry
Brown sun-burned appearance on the under surface of the leaves.
California Christmas-berry tingis, *Corythuca incurvata* Uhler. p. 170.

Laurel or sweet bay
Smutty galled leaves and greatly stunted trees.
Laurel psyllid, *Trioza alacris* Flor., p. 171.

Privet
Yellowing or fading leaves and dying plants.
Privet mite, *Tenuipalpus bioculatus* McG., p. 172.

Various trees

Wilting or broken twigs in midsummer bearing numerous small splintered punctures.

Periodical cicada, *Tibicina septendecim* Linn., p. 173.

Box Elder Plant-Bug

Leptocoris trivittatus Say

A moderately stout blackish red-marked bug about ½ inch long when full grown is sometimes extremely abundant on box elder in the western states.

The adults winter in sheltered nooks and corners, particularly in the crevices of stone walls and similar places and appear singly or in clusters on warm days. With the coming of spring they attack box elder and occasionally ash and soon scatter and deposit eggs. After midsummer all sizes of these bugs may be found in great numbers in lines up and down the trunks and branches of the trees, a habit which persists more or less until October and November.

The assembled insects may be destroyed by spraying with a contact insecticide, kerosene being desirable when the insects are clustered upon stones and in other places where there is no danger of injuring plants.

References

1895. Lintner, J. A., Insects, New York, 10th Rept., pp. 332–339.
1905. Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 239–240.

Norway Maple Leaf-Hopper

Alebra albostriella Fall.

Badly swollen apparently cankerous twigs and foliage infested with numerous small yellowish hoppers may be attributed to this insect.

The yellowish or yellowish-orange insects occurring on Norway maple, occasionally in large numbers, are about the same size as the much better known rose leaf-hopper. This pest has increased greatly in recent years and seriously injured Norway maples in the vicinity of New York City. The damage to the young twigs, a badly swollen apparently cankerous condition suggestive of fungus or bacterial disease, is caused by the abundant deposition of eggs just under the tender bark, in small oval cells about $\frac{1}{25}$ inch long. The surface of such twigs is slightly ridged and there are numerous small openings suggesting fungus infection and a consequent rupturing of the overlying tissues.

Spraying with a tobacco soap preparation in early spring has proven a very effective check.

Reference

1921, Felt, E. P., N. Y. State Mus. Bull. 231–232, p. 68.

Rose Leaf-Hopper

Empoa rosæ Harris

Minute white spots on the leaves or a general spotting and yellowing of the foliage accompanied by numerous, small, whitish, jumping insects are common signs of the work of this pest.

The rose leaf-hopper, sometimes incorrectly termed "thrips," is a very common widespread insect about $\frac{1}{10}$ inch long and easily controlled, since the over-wintering eggs are deposited in small blisters on the younger wood and the pale green recently hatched hoppers appear in early spring and confine their attack to the under surface of the leaves. Their presence is then indicated by minute white spots not at all suggestive of the general injury likely to follow when they become full grown and literally swarm upon the bushes, producing a badly spotted unhealthy foliage.

The delicate slow-moving young on the under surface of the leaves are easily destroyed by spraying with any contact insecticide, such as a tobacco soap preparation, and treatment at that time means immunity for the remainder of the season and practically no damage, provided there is not a reinfestation from near-by roses.

References

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 191–192.
1912, Felt, E. P., N. Y. State Mus. Bull. 155, pp. 65–68.

Rhododendron Lace-Bug

Stephanitis rhododendri Horv.

Unsightly yellowish or brown spotting of the leaves accompanied by more or less serious injury to the foliage is presumptive evidence of infestation.

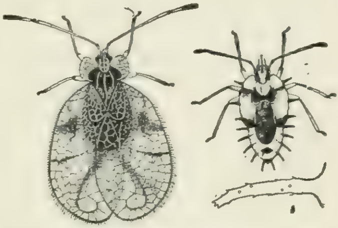

Fig. 101.—Rhododendron lace-bug, adult and young, greatly enlarged.

This native American species (Fig. 101) occurs on rhododendron and mountain laurel. The young and adults live on the underside of the leaves and in feeding produce a light mottling on the upper surface, while the opposite side is disfigured with numerous dark varnish-like spots of excrement. The insect winters in somewhat irregular cylindrical, flask-shaped eggs inserted on the lower surface, usually along the midrib and with the square cut end projecting slightly. The eggs hatch early in May, the young maturing early in June and laying eggs through that month and part of July, from which the second brood issues in August. The latter deposits the hibernating eggs and thus completes the life cycle.

Spraying the under surface of the leaves with whale-oil soap at the rate of six or seven pounds to fifty gallons of water has proven very effective. A nicotine soap solution should be equally efficient.

References

1910, Felt, E. P., N. Y. State Mus. Bull. 141, pp. 72–75 (*Leptobyrsa explanata*).

1919, Weiss, H. B., N. J. Dept. Agr. Circ. 26, pp. 36–37 (*Leptobyrsa*).

Azalea Lace-Bug

Stephanitis pyrioides Scott

The work of the azalea lace-bug is indicated by discoloration of the upper surface of the foliage, the leaves becoming almost white in severe cases and drying and dropping.

Azaleas in New Jersey are sometimes seriously affected with a small lace-bug presenting a general resemblance to the much better known rhododendron lace-bug. The injury is caused by the young and adults feeding on the under surface and causing a discoloration on the upper side of the leaves, which in severe cases may become almost white. The under surface is also disfigured by the excrement of the pests. The eggs, which remain unhatched over winter, are smooth, white, flask-shaped and deposited in the under surface of the leaves along the midrib and larger veins. The cap is sometimes visible as a whitish, oval or irregular circular ring and is sometimes covered with a brownish scab-like substance. As many as ninety eggs have been found upon one leaf. Hatching occurs the latter part of May in central and southern New Jersey; in the latter there are three generations, the average length of each being about a month.

Repeated spraying with whale-oil soap at the rate of five to six pounds to fifty gallons of water is the most satisfactory control measure.

Reference

1918, Weiss, H. B., N. J. Agr. Exp. Sta. Circ. 100, pp. 8–9.

California Christmas-Berry Tingis

Corythuca incurvata Uhler

A browned sun-burned appearance on the under surface of the leaves of the California Christmas-berry is indicative of injury by this insect.

The California Christmas-berry, *Heteromeles arbutifolia,* takes the place of the eastern holly and is sometimes seriously damaged by small lace-bugs and their young, the entire foliage turning to a brown unhealthy color. The effects of the attack are aggravated by the development in the honeydew of a black smut, *Capnodium heteromeles,* which results in a still more unsightly condition. The tingis is also recorded as occurring occasionally and in small numbers on the live oak, *Quercus agrifolia,* when the trees are near Christmasberry bushes.

The hibernating females begin egg-laying about the middle of March, depositing them upon the under surface of the leaves, the maximum oviposition occurring about the middle of April. The whitish oval eggs, about $\frac{1}{75}$ inch long, are inserted upright in the leaf, the broad half being beneath the surface and fitting snugly into an incision. The egg is then covered by a brown sticky substance, leaving a truncate cone-like elevation, a group of these suggesting miniature volcanoes with crater-like openings. There are several generations during the season, the period of activity lasting about eight months and in December most activities have ceased. The adults winter under fallen leaves, sticks and other shelter.

Cleaning up and burning rubbish and other shelter from December to March has resulted in a considerable decrease in the numbers of the pest. It is probable that thorough spraying of the under surface of the foliage with a good contact insecticide the last of April or at any time after the insects become numerous upon the leaves would prove a very effective check.

Reference

1911, Pemberton, C. E., Econ. Ent. Journ. 4:339–343.

Laurel Psyllid

Trioza alacris Flor.

Smutty galled leaves and greatly stunted trees may be caused by this insect.

The laurel psyllid winters in California as more or less active adults, the eggs being laid in March or April on the very small leaves of the tender shoots. The young feed upon the edges, cause a decided curling and thickening and produce definite leaf-galls, which latter gradually become lighter, later bright-reddish and eventually brown or black. There are several broods in California, the last maturing in October and November. Two generations are reported in Europe. This insect is recorded from laurel or sweet bay, *Laurus nobilis,* the cherry laurel or English laurel, *Prunus Laurocerasus,* and the canary laurel, *Laurus canariensis.* It also occurs in New Jersey.

The thick waxy secretion and the occurrence of the nymphs within leaf-galls make ordinary control measures ineffective. Fumigation with hydrocyanic acid gas readily kills all forms. Fumigating with tobacco, as for aphids, has given good results. Repeated and thorough applications of miscible oils or oil emulsions kill all stages not protected by galls.

References

1917, Essig, E. O., Econ. Ent. Journ. 10:439–444.
1921, Weiss, H. B., N. J. Dept. Agr., Bur. Statis. & Insp. Circ. 36, pp. 5–7.

Privet Mite

Tenuipalpus bioculatus McG.

Yellowing or fading privet leaves without marked discoloration may be the work of this pest.

This mite occurs on a number of plants aside from privet. The feeding is on the under surface of the leaves where reproduction continues until the foliage may be entirely over-run and swarming with mites in all stages of development. This is accompanied by a marked weakening of the foliage and a second crop of leaves may be developed. The destruction of the latter greatly weakens the plant and may be followed by death of the shrubs. The blood-red eggs are usually deposited with the long axis perpendicular to the leaf and, when the mite is abundant, there are often closely packed clusters of several hundred eggs. The life cycle may be completed in about three weeks and there are probably six or seven generations in the latitude of Batesburg, South Carolina.

Spraying with a lime-sulfur wash or potassium sulfide has given excellent control.

Reference

1916, McGregor, E. A., Econ. Ent. Journ. 9:556–561.

Periodical Cicada

Tibicina septendecim Linn.

Wilting or broken twigs in midsummer bearing numerous small splintered punctures may be the work of this species (Fig. 102).

The periodical cicada, one of the most interesting insects of North America, has a life cycle of seventeen years in the northern states and thirteen in the southern states and a brood distribution such that it appears in some section of the country every year. These broods are so well known and charted that it is possible to predict the appearance of the insect years in advance, even to within a few days of the time when the first adults appear. This cicada, sometimes known as the seventeen-year locust, is a forest insect and a very large proportion of its existence is as a subterranean grub-like form feeding upon the roots of forest trees. Toward the end of the period the full-grown grubs make their way to near the surface of the ground and under certain conditions construct peculiar above-ground chambers of pellets of soil. The large stout black insect is about 1¼ inches long and has a wing spread of nearly 3 inches, the veins of the fore-wings and the eyes being red. It appears above ground the last of May or in early June, and when at all numerous makes the woodlands resound with its shrilling. The injury to trees is a mechanical one, due to the females depositing eggs in slits cut in the smaller twigs and usually is not serious, though young trees may be damaged greatly. It is advisable to avoid planting small trees in areas where broods of cicadas are expected within two or three years and in case highly valued trees are threatened with injury, protection can be secured by covering them with netting.

Fig. 102.—Periodical cicada, lower one at rest on twig showing oviposition scars.

The dog-day cicada or harvest fly, *Tibicen tibicen* Linn., is a close relative of the periodical cicada, though easily distinguished by its larger size and dark green instead of reddish markings. It is found each summer in small numbers on trees and causes no appreciable injury. Its shrill note is rather common in late summer.

References

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 231–237.
1907, Marlatt, C. L., U. S. Dept. Agr. Bull. 71, pp. 1–179.

PART III

Forest Insects

An attempt has been made to segregate the more important enemies of timbered areas, because the treatment under such conditions is vastly different from that practicable in cities and villages. It is possible in this connection to discuss only a relatively small proportion of the large number of insects in woodlands and ordinarily these accounts should be considered as typical of groups or classes, rather than comprehending all of the species likely to be troublesome in woodlands. There are a great many borers in various trees, a number of additional species being noticed briefly in the systematic part under the metallic wood-borers and the long-horned beetles in particular. Similarly, many leaf-feeders are discussed under the groups to which they belong, as, for example, the sawflies in Part IV.

CHAPTER IX

THE FOREST INSECT PROBLEM

The forest insect problem is neither simple nor one that can be ignored. A brief outline of the situation is necessary to an adequate understanding of the problem. Only about three-fifths of the original timber remains in the United States. Less than 5 per cent of the virgin forests of New England and but 12 per cent of her original stand of timber are left. New York state now manufactures not more than one-tenth of the requirements of her own population and industries and Pennsylvania cuts less than the amount consumed in the Pittsburgh district. The original pine forests of the Lake states, estimated at 350 billion feet, are now reduced to less than eight billion feet. The bulk of the building and structural timbers used in the eastern and central states during the last twenty years was grown in the pine forests of the South. The cut of southern pine is falling off and within another decade promises to exceed by little, if at all, the requirements of the southern states themselves. The country is cutting more of every class of timber than it is growing. Even trees too small for the saw-mill are being used, on which our future lumber supply depends, three and one-half times as fast as they are being produced.[1]

Various states, through their forest officials, are promoting reforestation and some at least have established large state parks or natural recreation areas and provided for fire protec-

[1] The above data are from U. S. Dept. Agr. Circ. 112, prepared in response to Senate Resolution 311.

tion through the erection of fire towers and the organization of corps of observers. These are all steps in the right direction. Estimates prepared a few years ago placed the annual loss by forest fires at fifty million dollars and, surprising though it may be, the losses resulting from forest insects exceed this enormous total by a considerable figure and amount to $62,500,000 annually according to data prepared by A. D. Hopkins. Briefly, the United States is facing a serious shortage of forest products and as yet has done little toward preventing the tremendous losses caused by insects.

The control of forest insects is largely a question of judicious management supplemented by a knowledge of the more destructive insects and the best methods of preventing losses through their activities. Direct control or remedial measures are impracticable under present conditions.

It is well known that natural agents of one kind or another are exceedingly important factors in limiting the numbers of various insects. It is well recognized that many native birds perform a most valuable service in feeding on leaf-eating caterpillars and the apparent increase of insect depredations the last two decades or thereabouts appears to be correlated closely with a marked reduction in bird life. These facts should be more generally recognized and the wild life of the forest given better protection as a direct method of re-establishing a more normal balance between insect activities and forest growth, even if other considerations are given little weight.

Without question the character of the forest has a material influence on the development of insect life. Recent investigations, for example, have shown that the exceedingly destructive outbreaks of the spruce bud-worm are closely correlated with large areas in which mature balsam predominates. In other words, a broad forest policy which would effect a reduction in the proportion of balsam to that of other trees would go far toward eliminating this periodical menace to the enormous spruce forests and the resulting outbreaks by bark-beetles. A similar condition obtains in relation to the introduced gipsy moth, which thrives on oak, birch, willow and some other trees and is unable to maintain itself in pure stands of maple, pine and spruce. These are only two instances in which the danger of insect outbreaks can be lessened materially through a judicious forest policy.

The outbreaks by bark-borers discussed elsewhere originate largely in local unusually favorable conditions. In some instances they start, as intimated above, in trees weakened by defoliation, or they may originate in areas damaged by fire or blown down by wind. The production of millions of these little insects within a restricted area is a direct menace to adjacent forests. These insidious outbreaks can be detected and as their significance becomes more apparent a progressive forest policy will insist on such material being cut and handled in such a way as practically to eliminate danger of further damage. An insect patrol for the detection of small outbreaks would logically follow the fire protection now somewhat general.

Methods of lumbering should be scrutinized carefully for the purpose of eliminating conditions favorable to the great multiplication of destructive borers of various kinds, since it has been clearly established that an abundant slash is a most favorable breeding ground for destructive bark-beetles. The very injurious pin-hole borer outbreaks of the southern lumber region in particular undoubtedly occur through a superabundance of favorable breeding material, a condition which could be mitigated greatly if there were a general recognition of the important factors involved.

Healthy rapidly growing trees are less subject to insect attack than those which have attained maturity or have been weakened through various causes, consequently cutting trees at their prime or shortly thereafter and the removal so far as practicable of sickly or dying trees lessen the probability of serious insect losses.

The handling of the logs or lumber in the forest, at the mill and in the mill yard should be scrutinized carefully for the purpose of correcting faulty methods which frequently result in very material losses.

The extensive and justifiable planting of forest trees in areas unsuitable for other purposes is bringing to the front another phase in relation to insects and trees. These young trees are put out in various environments and sometimes under conditions which will inevitably result in serious injury, as, for example, young pines in a section in which many of the older trees have the rounded bushy top indicative of earlier and persistent injury by the white pine weevil. In some cases more than 50 per cent of the young pines from 2 to 5 feet in height are seriously damaged or killed by this insect. Plantings under such conditions are unwise, unless provisions are made either to protect the trees during the critical period or offset the loss to a large extent by somewhat thick planting, the method adopted depending to a great degree on local conditions. The pales weevil is another dangerous enemy of young conifers and reasonable precautions should be adopted to prevent injury to the seedlings.

Planting young trees in extensive grassy or coarse herbaceous growths exposes them in the former case to danger of injury by grasshoppers and in the latter by tree crickets. Grasshopper injury is only occasional and largely can be prevented before it becomes serious by the judicious use of poison bait. The probabilities of damage by tree crickets may be reduced greatly by burning areas with coarse herbage and briars in late fall or early spring, thus destroying the eggs within the stems.

Black locust has been extensively planted in some parts of the country. It is very liable to injury by the locust borer and is sometimes seriously damaged by leaf-feeding insects. The conditions favorable to borer infestation should be avoided carefully so far as possible if one would escape serious losses.

The planting of forest trees should not be undertaken without some recognition of the dangers threatening their early growth and the avoidance, so far as practicable, of conditions favorable to serious injury. It even may be advisable under some conditions to adopt direct control or remedial measures.

CHAPTER X

DECIDUOUS FOREST TREE BORERS

A VERY large number of borers occur in forest trees. The more injurious ones attack the trunk and the larger limbs and make extensive galleries in the cambium layer. Outbreaks of this character are usually preceded by the somewhat general occurrence of the insects in a few trees or in restricted areas and under certain conditions, at least, the attack can be checked by the judicious cutting and disposition of the affected trees. A host of borers occur in sickly and dead timber, being secondary rather than primary. It is very desirable to distinguish between these two classes.

KEY TO PRINCIPAL BORERS IN DECIDUOUS FOREST TREES

Borers in limbs of dying or sickly trees
  Yellowish-white flat-headed grubs in broad sinuous galleries.
    Lurid dicerca, *Dicerca obscura* var. *lurida* Fabr., p. 183.

Twig girdlers in various trees
  Girdled and occasionally severed twigs and branches.
    Twig-girdler, *Oncideres cingulatus* Say, p. 184.
  Stout, cylindrical, black, red-shouldered beetles, $\frac{1}{5}$ inch long in cylindrical powder-filled galleries of dying limbs.
    Red-shouldered twig-borer, *Xylobiops basillare* Say, p. 184.
  Small areas of fading yellow, red or brown foliage, on live oak.
    Pacific oak twig-girdler, *Agrilus angelicus* Horn, p. 186.

Borers in solid wood of various trees
  Slender grubs, $\frac{3}{4}$ inch long, $\frac{1}{20}$ inch thick.
    Northern brenthian, *Eupsalis minuta* Drury, p. 187.
  Extensive blackened galleries in sapwood and heartwood of chestnut.
    Chestnut timber worm, *Melittomma serviceum* Harr., p. 187.

Hickory borers
  Blackish golden-marked beetles about ¾ inch long.
    Painted hickory borer, *Cyllene pictus* Drury, p. 188.
  Brownish beetles about 1 inch long.
    Banded hickory borer, *Chion cinctus* Drury, p. 188.
  Tawny gray beetle about 1 inch long.
    Tiger hickory borer, *Goes tigrinus* DeG., p. 190.
  Blackish beetle about ½ inch long, also in oak and other trees.
    Rustic borer, *Xylotrechus colonus* Fabr., p. 190.

Ash
  Dark purple yellowish beetles about ½ inch long.
    Banded ash borer, *Neoclytus caprœa* Say, p. 191.

Borers in dead wood
  Thick fleshy grubs some 3 inches long in roots and stumps.
    Broad-necked prionus, *Prionus laticollis* Drury, p. 191.
  A rather slender brownish beetle about 1½ inches long.
    Lesser prionus, *Derobrachus brunneus* Forst., p. 192.
  Stout, whitish, round-headed borers in heartwood.
    Parandra borer, *Parandra brunnea* Fabr., p. 193.
  A blackish white-marked beetle, 1½ inches long and with two eye-like spots on the thorax.
    Owl beetle, *Alaus osculatus* Linn., p. 194.

Borers in dried or seasoned hard wood
  Very fine mealy borings, especially in sapwood.
    Powder-post beetles, *Lyctus* spp. and others, p. 194.

Lurid Dicerca

Dicerca obscura var. *lurida* Fabr.

The flat-headed yellowish-white grubs bore in the trunks and limbs of pignut and hickory, transforming to flattened, hard-shelled, lurid, dull brassy colored beetles about ½ inch long. This brilliant beetle may be found during June and July upon the limbs of dying or sickly trees. The grubs make shallow galleries in the affected branches. The insect is widely distributed.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 442–443.

Twig-Girdler

Oncideres cingulatus Say

Girdled and occasionally severed twigs and branches of various trees may be the work of a thick-bodied long-horned beetle (Fig. 103).

Fig. 103.—Twig-girdler and work.

This beetle is a true twig-girdler in that it cuts a broad girdle around the twig, not leaving the severing of the branch to the larvæ as in the case of the oak and maple twig-pruner. The adult is a stout brownish beetle from ½ to ¾ inch long with distinctly darker brown markings on the base of the antennæ and at the base and near the middle of the wing-covers. There are also well-developed spines on each side of the thorax. The beetles appear the last of August and early in September, deposit their eggs just beneath the bark of the girdled shoots and at the base of side shoots or aborted buds, the larvæ wintering in the fallen twig. This species occurs upon a considerable variety of plants, such as persimmon, oak, pecan, apple, pear, quince, peach and orange.

The collecting and burning of the fallen twigs is an effective control measure.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 271–274.

Red-Shouldered Twig-Borer

Xylobiops basillare Say

The small, cylindrical, stout, black, red-shouldered beetle (Fig. 104) about ⅕ inch long is occasionally reared from the branches of hickories and other deciduous trees in large numbers.

This insect appears to be restricted almost entirely to the smaller limbs, those 4 inches in diameter or less, of hickory and other trees in a dying condition. The grubs make numerous, frequently almost contiguous, cylindrical, usually longitudinal, galleries about ⅛ inch in diameter throughout all parts of the wood. The galleries are almost invariably filled with mealy wood powder. A cross-section of a badly infested limb frequently shows an almost completely riddled condition. The beetles issue from circular shot-hole-like exits. This species has been recorded also from persimmon, mulberry, apple, peach and grape, and Hopkins states that it infests most other deciduous trees. It appears to be distributed generally in the northeastern United States.

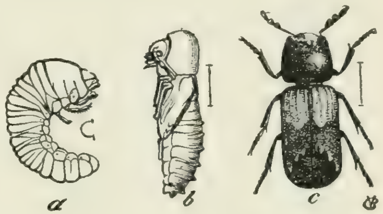

FIG. 104.—Red-shouldered twig-borer, larva, pupa and adult, enlarged.

The closely related western *Scobicia declivis* Lec. breeds freely in the dead or dying limbs of various oaks and also of a number of other trees, presumably being somewhat general in its food habits. This species has recently attracted much attention because of its piercing the lead sheathing of aerial cables. An exhaustive account of this insect and its work is given by Messrs. Burke, Hartman and Snyder in the United States Department of Agriculture Bulletin 1107, 1922.

REFERENCE

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, p. 442.

Pacific Oak Twig-Girdler

Agrilus angelicus Horn

Large and small live oaks thickly spotted with small areas of fading yellow, red or brownish foliage are probably infested with this pest.

The patches of fading foliage in connection with the small mine with its winding course under the bark is characteristic of this borer. The gallery for the first year is only a few inches long and during the second it may be extended for a foot or more, sometimes two feet, the burrow having a spiral direction around the branch and killing the portion beyond. The foliage on affected twigs varies from a fading green to reddish-brown. Most of the branches killed are not over ½ inch in diameter. The borer is about ¾ inch long when full grown, whitish, the mouth-parts and tip of the posterior extremity dark brown or black. The eggs hatch during June and July, and by the middle of the first winter the larva is about ¼ inch long. At the end of the second summer it is about ⅔ inch long, the adults issuing the following season. The life cycle, therefore, requires two years.

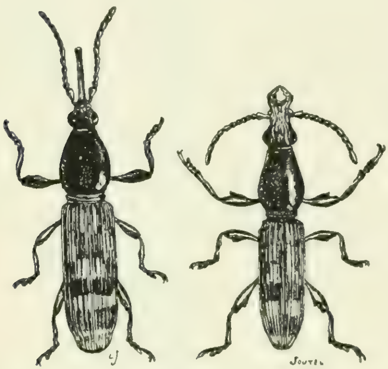

Fig. 105.—Northern brenthian, enlarged.

Cutting and burning infested twigs about April 1st is the most effective control measure. Many of the borers are parasitized, consequently it is better practice to keep the infested twigs in a box or barrel tightly covered with sixteenmesh wire screen so that the beneficial parasites may escape. Spraying with poisons kills some of the beetles.

Reference

1920, Burke, H. E., Econ. Ent. Journ. 13:379–384.

Northern Brenthian

Eupsalis minuta Drury

A slender grub ¾ inch long and not quite $\frac{1}{20}$ inch thick bores in the solid wood of white oak and changes to a peculiar weevil with a rather prolonged thick snout (Fig. 105). This remarkable somewhat sluggish weevil is found in small numbers on oak, although it has been recorded from chestnut, beech, elm, cypress and presumably occurs on other trees. The grubs make extensive galleries in the solid wood and the insect presumably has a wide distribution in the northeastern United States.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 261–263.

Chestnut Timber Worm

Melittomma sericeum Harris

Extensive galleries in the wood of living and dead chestnut and oak are frequently made by a slender white grub with a conspicuous hump behind the head and a dark brown, obliquely truncate, serrate posterior extremity.

This is a very destructive timber borer, since it tunnels the sapwood and heartwood of chestnut in all directions, though its blackened galleries are frequently oblique and along the lines of growth. Entrance is effected at some wound or where a limb has broken off. Its work in chestnut is so abundant in many sections as to cause material depreciation in the value of the timber. The adult is a slender, chestnut-brown, yellow-haired beetle about ½ inch long. The larva is white, slender, cylindrical and about ¾ inch long. It has a peculiar hump behind the light yellowish head and a hard, dark brown, excavated, obliquely truncate posterior extremity margined with stout quadrate teeth.

All fallen or dead timber should be removed from the forest as soon as practicable since this insect breeds readily in dead trunks. Unnecessary blazing should be avoided because wounds are very favorable to infestation by this borer.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, p. 449.

Painted Hickory Borer

Cyllene pictus Drury

This is a blackish golden-marked beetle (Fig. 106) about ¾ inch long, which is frequently bred from hickory logs. This species is remarkable in its very close resemblance to the locust borer, *Cyllene robiniæ* Forst., some holding the two to be identical, though certain differences appear to be fairly constant. The hickory beetles, however, appear in the spring, whereas the locust beetles are abroad in the fall. It has also been reared from black walnut, butternut, mulberry and osage orange.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 264–266.

Banded Hickory Borer

Chion cinctus Drury

A brownish beetle may be found on cut hickory the latter part of May, the large fleshy grubs making irregular longitudinal burrows in the wood.

This species is more or less common wherever hickory grows. It works mostly on cut timber and wood that has been allowed to lay for a year or two after felling. Then it is frequently so full of galleries that its value even for fire wood is greatly

FIG. 106.—Painted hickory borer, adult, pupa and work.

diminished. The parent insect is a grayish-brown beetle about 1 inch long, commonly with a yellowish oblique band on each wing-cover. The beetles are abroad the latter part of May. The insect is widely distributed, although not abundant in the northeastern United States.

Cutting in fall or early winter or peeling the bark is believed to afford considerable immunity from attack.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 267–268.

Tiger Hickory Borer

Goes tigrinus DeG.

The large creamy-yellowish grubs of this species make big holes lengthwise in the inner bark and sapwood of living hickory, oak and possibly some other trees.

This insect has been characterized by Packard as perhaps the most common borer in hickory and walnut in the southern states. The beetle is about 1 inch long, brown and covered with a short, tawny, gray pubescence which is more dense on the wing-covers, the latter with a broad dark brown band beyond the middle and another at the base. The grub has been recorded from the inner bark, sapwood and the solid wood of hickory and oak.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 268–269.

Rustic Borer

Xylotrechus colonus Fabr.

Broad, irregular, shallow galleries in the inner bark and outer sapwood of oak, hickory and other trees may be the work of this species.

The blackish beetles (Fig. 107), some ½ inch long, variably marked with yellowish or slaty white, are sometimes reared in enormous numbers from infested trees. The adults appear in May and the eggs are probably deposited in crevices of the bark. It is a well-known oak and hickory borer and also occurs in chestnut, ash and elm.

The western *X. nauticus* Mann. works in the twigs and branches of the coast live oak and attacks a number of other trees.

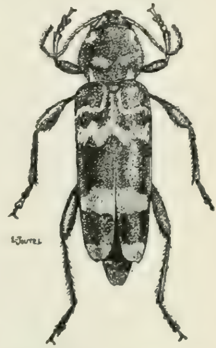

FIG. 107.—Rustic borer, enlarged.

REFERENCES

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 259–261.
1915, Essig, E. O., Inj. Ben. Ins. Cal., pp. 254–255.

BANDED ASH BORER

Neoclytus caprœa Say

Logs of black ash and dying trees are frequently injured by this borer. The beetle is about ½ inch long, mostly dark purple with narrow yellow lines on the thorax and three yellow bands upon the wing-covers. It has also been reared from the limbs and trunk of elm and hickory and presumably has somewhat general food habits.

REFERENCE

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 279–280.

BROAD-NECKED PRIONUS

Prionus laticollis Drury

The thick, fleshy, legless grub, some 3 inches long when full grown, bores in the roots and stumps of a number of trees.

This large beetle (Fig. 108) measures about 1½ inches long and nearly ½ inch in width. It varies from brown to very dark brown or black and is a common insect in the northeastern United States. The work of the grubs is usually limited to comparatively worthless forest trees, although occasionally highly valued oaks may be injured seriously. It has been recorded from pine, various oaks, linden, poplar, chestnut, apple and grapevine. The western *P. californicus* Mots. likewise occurs in a considerable variety of trees.

FIG. 108.—Broad-necked prionus, enlarged.

FIG. 109—Lesser prionus.

REFERENCE

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 486–487.

LESSER PRIONUS

Derobrachus brunneus Forst.

This is a rather slender brown beetle (Fig. 109) about 1½ inches long and less than ½ inch broad. This insect is common amongst our larger beetles. The larvæ live almost entirely in decaying wood and have been recorded from pine, hemlock, hickory, walnut, oak and chestnut. It is said to occur in the decaying logs and stumps of nearly all forest trees.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 487–488.

Parandra Borer

Parandra brunnea Fabr.

The stout, whitish, round-headed borers rather commonly found in the heartwood of a great variety of trees may be of this species.

This borer, when full grown, is about an inch long and resembles the common round-headed apple tree-borer except for the strong forward slope of the thorax and the small low-set head. It works commonly in the heartwood usually within a few feet of the ground and frequently attacks the living and dead heartwood and sapwood. Beech appears to be preferred, although it occurs freely in pine, black walnut, hickory, willow, chestnut, oak, elm, maple, ash and other trees. Entry is effected at dead or decaying places on the surface. Three years are probably necessary for the completion of the life cycle. The parent beetle is glossy, chestnut-brown and usually less than ¾ inch long. The insect has been reported as causing serious injury to chestnut telegraph poles.

Keeping trees in a healthy condition and protecting cut surfaces are excellent preventives against attack by this insect. Impregnating poles with creosote by some standard process is advisable.

References

1910, Snyder, T. E., U. S. Dept. Agr., Bur. Ent., Bull. 94, Part I, pp. 1–12.
1911, Gahan, A. B., Econ. Ent. Journ. 4:299–301.
1911, Hart, C. A., Ill. State Ent., 26th Rept., pp. 68–73.
1915, Brooks, F. E., U. S. Dept. Agr. Bull. 262, pp. 1–7.
1922, Britton, W. E., Conn. State Ent., 21st Rept., pp. 201–202.

Owl Beetle

Alaus oculatus Linn.

The owl beetle (Fig. 110) is large, rather stout, black, finely white-marked, some 1½ inches long and bearing two conspicuous eye-like spots on the thorax.

This, our largest snapping beetle, attracts attention on account of its size. It is rather commonly found in or about rotting wood and for a time its larva was supposed to be a borer in such materials. It now seems rather clearly established that the larva preys on borers found in rotting wood. This insect is able to throw itself into the air as well as the smaller more common snapping beetles. This is possible by means of a peculiar springing apparatus on the ventral surface. A stout spine on the thorax projects back in a socket in the abdomen and by bending its body backward, the beetle can raise the spine and rest it on the edge of the socket and then with a sudden muscular exertion spring it back into the cavity. The impact throws the insect into the air to a height several times its length and is commonly used to enable the beetle, when bottom side up, to regain its feet.

Fig. 110.—Owl beetle, enlarged.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 485–486.

Powder-Post Beetles

Lyctus spp. and others

Fine white dust-like borings and numerous minute holes in the sapwood of well-dried hardwoods are characteristic signs of infestation by several slender, reddish-brown or black beetles less than $\frac{1}{4}$ inch long (Fig. 111).

There is in this group an introduced European species, *Lyctus linearis* Goeze, and the American *L. planicollis* Lec., *L. parallelopipedus* Melsh. and *L. cavicollis* Lec., the first of the three native species being southern, the second eastern and southern and the third western. A somewhat stouter dark-brown beetle with beautiful branching antennæ and known as the small red-horned borer, *Ptilinus ruficornis*, may occur in seasoned wood, particularly birch and maple, and produce very similar injuries. These different species have somewhat the same habits and attack a great variety of seasoned hardwood, especially hickory, ash and oak and injure such stock as hubs, spokes and other parts of vehicles, not excluding automobiles, and may attack beams and the interior finish or trim and ornamental woodwork in dwellings and parts of furniture, such as tables, chairs, bookcases, and the like.

Fig. 111.—Powder-post beetle, enlarged.

A large variety of woods are affected in addition to those mentioned above, such as black walnut, butternut, maple, elm, orange and bamboo. Wood that has been seasoned a year or more is especially liable to attack. These beetles are widely distributed over the world and consequently infestation is somewhat general. The slender white eggs are deposited in the pores of the wood and the young grubs burrow in all directions. When full grown they are yellowish-white, about $\frac{1}{8}$ inch long, and have the tip of the body curved toward the head. The beetles commonly emerge in late spring and early summer.

The loss occasioned by these minute insects ranges from 1 to 50 per cent of the value of seasoned hardwood products and amounts to an enormous total for the entire country.

The danger of infestation increases with the length of time wood is held in storage, and under certain conditions infested stock is a menace to human life as in the case of weakened ladder rungs or essential parts in the construction of vehicles.

The piling of second growth, white wood or sapwood, especially hickory, ash and oak for several years, is very favorable to infestation by powder-post beetles, especially if old stock is allowed to accumulate and serve as a breeding center. Piling the different kinds of hardwood separately lessens the probabilities of infestation. It is very desirable to eliminate useless sapwood in sheds or yards and avoid the use of sapwood piling sticks for the same reason. Partially damaged material should be burned, preferably between October and the 1st of March, the period when the insects are all in the wood.

The pests may be destroyed in the wood by painting with kerosene, or three parts creosote and one part kerosene oil, or three parts kerosene and one part creosote in order to obtain deeper penetration. One part creosote and three parts naphtha have been used very successfully. Spraying or painting equivalent to a liberal wetting with orthodichlorobenzene is recommended. Such wood should be kept by itself until certain that all the borers have been killed. The use of oils, pure or diluted, involves a fire hazard and possibly may be detrimental to the wood for certain purposes.

The fumes from paradichlorobenzene crystals are protective. Eight to ten pounds should be used to 1,000 cubic feet in ordinary rooms and two or four pounds in sealed or airtight rooms.

Steaming under pressure, although it weakens and discolors the wood, kills the insects. They also may be destroyed by subjecting the seasoned wood to temperatures of over 200° F. in dry kilns. Fumigation with the fumes of sulfur, when the insects are emerging, has been recommended for killing the beetles and preventing egg-laying.

Much may be accomplished by the adoption of systematic preventive measures, such as annual inspections during the cooler months of the year and the keeping of woods most likely to be infested, such as hickory, ash and oak, by themselves, remembering that the older seasoned wood is most liable to attack. This last should be disposed of as rapidly as possible. The accumulation of refuse material should be avoided and only heartwood piling sticks used in lumber piles. Care should be taken to avoid the introduction into lumber yards and storehouses of powder-posted material.

Stock that has been seasoned longer than eight months may be rendered immune by treating with two coats of boiled linseed oil applied hot or it may be immersed in vats of hot oil. This oil stains the wood slightly yellow. This is not objectionable in the case of ordinary wagon stock. Creosotes may be used for wood in which a brown stain is not detrimental.

Any substance which closes the pores of wood, such as paraffine, wax, varnish, and the like, will protect finished products from infestation. The sapwood portions of interior surfaces of cabinet work, trim and furniture, should be treated to prevent attack.

Powder-post injury occasionally develops in buildings, vehicles and other places where preventive or control measures indicated above can not be applied. Recent experiments in super-heating of buildings indicate that a temperature of 135° F., preferably somewhat higher, maintained for a period of twenty-four hours, will destroy the insects within the wood. This is certainly worth trying in dwellings and other places where infested wood can not be removed and treated without great expense. This will not prevent reinfestation. It may kill all the insects.

References

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 296–298.
1917, Hopkins, A. D., and Snyder, T. E., U. S. Dept. Agr. Farmers' Bull. 778, pp. 1–20.
1922, Alston, A. M., Timber Trades Journal, April 15 to May 13, separate, pp. 1–24.
1922, O'Kane, W. C., and Osgood, W. A., N. H. Agr. Exp. Sta. Bull. 204, pp. 1–20.

CHAPTER XI

DECIDUOUS FOREST TREE LEAF-FEEDERS

A NUMBER of species are more or less abundant each year and a few become exceptionally numerous at irregular intervals, the latter class being represented by the forest tent-caterpillar, the measuring-worms of the snow-white linden moth and the birch leaf-skeletonizer. The better protection of bird life is one of the most effective natural checks against outbreaks of this character. There appears to be a close relation between a marked reduction in the bird life of the country some thirty years ago and an increase in the number and severity of attacks by these pests.

KEY TO VARIOUS LEAF-FEEDERS

Hickory and other trees

Large bluish-green caterpillar with four long horn-like projections, length 5 inches, also on other trees.

Hickory horned devil, *Citheronia regalis* Febr., p. 201.

White, black-dotted, black-tufted, hairy caterpillars from July to September, also on other trees.

Hickory tussock moth, *Halisidota caryæ* Harr., p. 202.

Reddish, white-striped or blackish, white-haired caterpillars, length ¾ to 1½ inches.

Black walnut caterpillar, *Datana integerrima* Gr. & Rob., p. 203.

Yellowish-green caterpillars, ½ inch long, feed in developing buds.

Pecan bud-worm, *Proteopteryx bolliana* Sling., p. 203.

Oaks

Black spiny caterpillars with four orange-yellow stripes, length 1½ inches.

Yellow-striped oak caterpillar, *Anisota senatoria* Abb. & Sm., p. 204.

Black spiny caterpillars, length 2 inches.

Buck or Maia moth, *Hemileuca maia* Drury, p. 205.

Olive-green, black and yellow, longitudinally striped caterpillars, 1½ inches long.
California oak moth, *Phryganidia californica* Pack., p. 206.

Maple

Brownish-black, yellow-marked measuring-worms some 2 inches long and with a dull reddish or yellowish-brown head, occur also on beech, hickory, chestnut and other trees.
Snow-white linden moth, *Ennomus subsignarius* Hubn., p. 208.

Long, tapering, blackish, trumpet-like tubes containing caterpillars, on red maple.
Maple trumpet skeletonizer, *Thiodia signatana* Clem., p. 210.

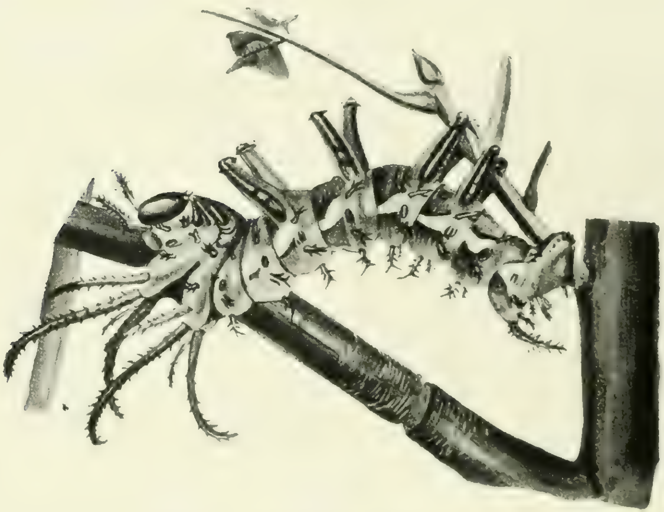

FIG. 112.—Hickory horned devil.

Irregular oval holes about ½ inch in diameter in leaves and similar cases, on sugar maple.
Maple leaf-cutter, *Paraclemensia acerifoliella* Fitch, p. 211.

Birch

Skeletonized or browned white birch leaves in late summer.
Birch leaf-skeletonizer, *Bucculatrix canadensisella* Chamb., p. 213.

Willow

Greenish-black yellow-spotted sawfly larvæ about ½ inch long.
Yellow-spotted willow slug, *Pteronus ventralis* Say, p. 213.

Reddish black-spotted beetles about ¼ inch long.
Spotted willow leaf-beetle, *Lina lapponica* Linn., p. 215.

Alder

Bluish flea-beetles about ⅕ inch long or black grubs.
Alder flea-beetle, *Haltica bimarginata* Say, p. 215.

Hickory Horned Devil

Citheronia regalis Fabr.

The large bluish-green caterpillar with four conspicuous horn-like projections on the thoracic segments and a number of smaller ones occurs in September on hickory and other trees.

Fig. 113.—Regal moth, parent of hickory horned devil.

This is one of our largest native caterpillars (Fig. 112), measuring some 5 inches when full grown and in a crawling attitude. The general color is green with a yellowish cast. There are on the thoracic segments eight serrate horns, four small and black and the other four quite long, orange-brown or red with black extremities. The popular name is somewhat suggestive of the appearance of the caterpillar. The moth (Fig. 113) is one of our most magnificent insects with a wing spread of about 6 inches, the markings being reddish-brown and yellowish. Ordinarily this large caterpillar is not sufficiently abundant to cause material injury.

REFERENCE

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 305–306.

HICKORY TUSSOCK MOTH

Halisidota caryæ Harris

Snow-white, black-dotted, black-tufted caterpillars occur in July, August and September on the tender leaves of hickory and other trees.

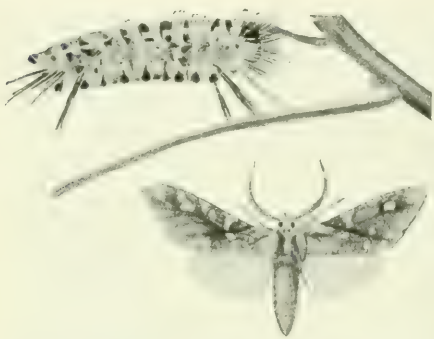

FIG. 114.—Hickory tussock moth, larva and adult.

This insect (Fig. 114) is rather common in New York state and is a somewhat general feeder, although it shows a decided preference for walnut, butternut and sumac and is said to be common on elm, ash and linden. Occasionally it is present in such large numbers as to cause considerable injury to various trees in limited localities. The full-grown caterpillars are about $1\frac{1}{2}$ inches long, very hairy and are most easily recognized by the two long black pencil-like tufts on the fourth and tenth segments and the white hairs in short spreading tufts with a row of eight black tufts along the back. The final transformations occur in oval thin hairy cocoons under stones or in crevices, the moths flying the following June.

REFERENCES

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 314–315.
1918, Houser, J. S., Ohio Agr. Exp. Sta. Bull. 332, pp. 246–247.

Black Walnut Caterpillar

Datana integerrima Grote and Robinson

Reddish, white-striped or blackish white-haired caterpillars (Fig. 115), from 3/4 to 1 1/2 inches in length, feed in large clusters in midsummer on hickory, black walnut, butternut and other trees.

This is one of the commonest defoliators of hickories in the northeastern United States, the trees frequently being entirely stripped. The whitish hemispheric eggs approaching a cylindrical form are deposited in masses of 300 or more on the underside of the leaves. The recently hatched caterpillar is about 1/5 inch long, with a brick-red body and with a faint subdorsal, a lateral yellowish stripe and a lower diffused yellowish line. The third stage, nearly 3/8 inch long, is of a deeper yellow color with the yellowish lines more distinct. The full-grown caterpillar varies from a deep reddish-brown to a jet black, there being in both rather long flossy whitish hairs. Full growth is attained in September, when the caterpillars enter the ground, the moths appearing the following spring.

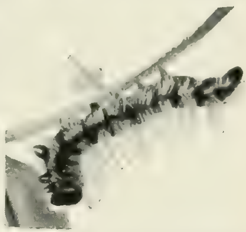

Fig. 115.—Black walnut caterpillar.

Spraying with a poison will kill these caterpillars, although this is usually impracticable.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 303–305.

Pecan Bud-Worm

Proteopteryx bolliana Sling.

The yellowish-green caterpillars about 1/2 inch long feed in early spring in the developing buds of pecans and presumably hickories, causing a stunted growth and excessive branching.

This insect appears to be a pest of nursery and newly set trees, sometimes occurring in considerable numbers and causing rather serious mischief. There are at least five generations in south Georgia, the earlier ones feeding on the new and tender shoots and the later working upon the leaves. The moths of this insect winter and begin to lay their first eggs on the branches near the buds, the later ones upon the upper surface of the leaves. The caterpillars feed from three to four weeks and the time necessary to complete a life cycle is but forty days. The most serious injury is caused by the first-brood caterpillars.

When the pest is abundant, it can be controlled to some extent by spraying with an arsenical poison just as the buds are opening. Ordinarily it is not serious in bearing orchards.

Fig. 116.—Yellow-striped oak caterpillar, work, full grown and parasitized larvæ and male moth, reduced.

References

1917, Gill, J. B., U. S. Farmers' Bull. 843, pp. 25–27.
1918, Turner, W. F., Ga. State Bd. Ent. Bull. 49, pp. 21–22.

Yellow-Striped Oak Caterpillar

Anisota senatoria Abbott and Smith

A black spiny caterpillar with four orange-yellow stripes on the back and two along each side frequently strips the foliage from scrub and other oaks in midsummer.

This leaf-feeder (Fig. 116) is common in scrub-oak regions of the northeastern United States and is occasionally extremely abundant and injurious. The moths appear early in June and deposit 500 or more whitish eggs in irregular clusters on the under surface of the leaves. Oviposition extends over a period of three or four weeks, consequently there is considerable variation in development, some becoming full grown the latter part of August and others about a month later. The winter is passed in earthen cells, the moths appearing as indicated above.

This insect is easily controlled by poison sprays, although ordinarily these are impracticable.

References

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 306–310.
1918, Houser, J. S., Ohio Agr. Exp. Sta. Bull. 332, pp. 249–251.

Buck or Maia Moth

Hemileuca maia Drury

The small black spiny caterpillars of this insect occur in early summer, feeding gregariously on the leaves of various oaks, especially in swampy places.

Fig. 117.—Buck or Maia moth.

The buck moth (Fig. 117) is occasionally associated in some numbers with the yellow-striped oak caterpillar, although ordinarily it is much less abundant. The moths issue from the ground late in September or early in October and the eggs are deposited in small masses, 70 to 200, encircling twigs. The young caterpillars hatch the latter part of May and attain maturity in July. The full-grown caterpillar is about 2 inches long, has a red head, rows of long branching spines on the blackish body except for a median line of brown-red spots on segments five to eleven and a reddish, mottled, sublateral area. Transformations occur in the ground, the moths issuing in the fall.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 310–314.

California Oak Moth

Phryganidia californica Pack.

Olive-green, black and yellow, longitudinally striped caterpillars 1 to 1½ inches long defoliate various oaks.

Fig. 118.—California oak moth.

This species (Figs. 118–121) not infrequently defoliates large oak trees over considerable areas. There are two generations. The winter brood hatches from eggs late in the autumn on the leaves of live oak and deciduous oaks, the larvæ hatching, and only those on the live oaks surviving. Transformation to adults occurs in May and June and eggs are again laid upon the new foliage of the deciduous oaks as well as upon the leaves of the live oaks about the last of June. These develop into the large and very destructive summer brood, the caterpillars becoming full grown in September and October. Transformation to the adult occurs in free hanging pupæ. The moths of the two broods fly in June and November, respectively. A third brood is reported, although this appears to be unusual.

The caterpillars are readily destroyed by arsenical poisons, applied preferably the last of July or early in August.

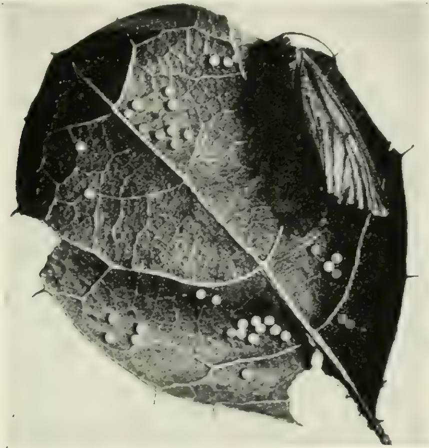

FIG. 119.—California oak moth, adult and eggs.

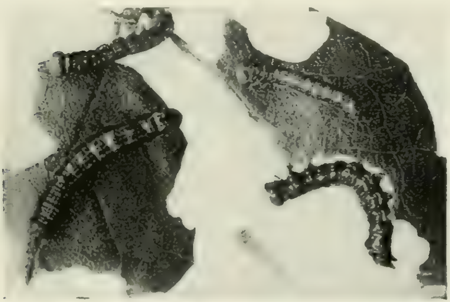

FIG. 120.—California oak moth, larvæ and work.

REFERENCES

1915, Essig, E. O., Inj. Ben. Ins. Cal., pp. 403–405.
1920, Burke, H. E., U. S. Dept. Agr. Farmers' Bull. 1076, pp. 1–14.

Snow-White Linden Moth

Ennomus subsignarius Hubn.

A brownish-black, yellow-marked, looping caterpillar or measuring-worm with a dull reddish or yellowish-brown head

Fig. 121.—California oak moth, larvæ and pupæ.

may defoliate beech, maple, hickory and chestnut in early summer.

Fig. 122.—Snow-white linden moth.

This insect (Figs. 122–124) is best known because of its serious injuries to shade trees prior to about 1880. The English sparrow appears to have driven it from cities and villages and it is now a forest pest, which occasionally becomes exceedingly abundant, defoliating extensive areas and the snow-white moths attracting attention in midsummer as they fly to the lights of cities and villages. The adults are abroad the last of July and early in August and shortly deposit their somewhat barrel-shaped light-brown eggs in irregular masses on the bark of trees. The young caterpillars appear with the unfolding foliage and attain full growth in five or six weeks, the last of July. The full-grown caterpillar is 2 inches long, has a dull reddish or yellowish-brown head, and the body is mostly dull brownish-black with irregular yellowish markings on the sublateral lines. The yellowish-brown irregularly black-spotted pupæ occur among the leaves and are sheltered with very light, thin, yellowish-brown cocoons. The moth is rather slender-bodied, usually snow-white and with a wing spread of about 1½ inches. Better protection for birds is the most promising method of preventing outbreaks.

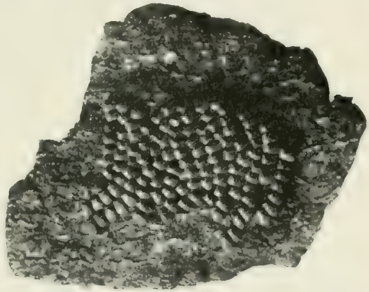

Fig. 123.—Snow-white linden moth, eggs, enlarged.

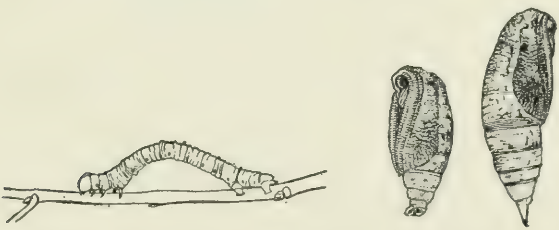

Fig. 124.—Snow-white linden moth, larva and pupæ.

References

1908, Felt, E. P., N. Y. State Mus. Bull. 124, pp. 23–28.
1909, Felt, E. P., N. Y. State Mus. Bull. 134, pp. 51–54.
1910, Felt, E. P., N. Y. State Mus. Bull. 141, pp. 100–102.
1911, Felt, E. P., N. Y. State Mus. Bull. 147, pp. 62–64.

Maple Trumpet Skeletonizer

Thiodia signatana Clem.

Red maple leaves loosely folded in August and September may contain a long, tapering, blackish, trumpet-like tube, the adjacent tissues being skeletonized (Fig. 125).

Fig. 125.—Maple trumpet skeletonizer, work.

This insect has attracted little attention in economic literature, although it seems to be rather common on the red and to a much smaller extent on sugar maples. It is probable that its work is overlooked, as a rule, because the insect appears so late in the season that the injury is very slight even though the skeletonizer is somewhat abundant. The full-grown caterpillar is light green with a yellowish head and about ½ inch long. The insect can be controlled readily by the timely and thorough application of an arsenical poison.

REFERENCE

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 168–169.

MAPLE LEAF-CUTTER

Paraclemensia acerifoliella Fitch

Sugar maple leaves with irregular oval holes about ½ inch in diameter (Fig. 126) may have been injured by this leaf-cutter.

This is one of the smaller more interesting woodland insects, which occasionally becomes exceedingly abundant and somewhat destructive in limited areas, especially in the Adirondacks. The work is characteristic, since the small caterpillar reaches out from its oval case and eats all that is within range and then migrates to another spot. Infested leaves may, therefore, show one or more oval holes with circular skeletonizing here and there, the centers of some of the areas at least being occupied by an oval case with a diameter of about ⅝ of an inch. This work is usually upon the upper surface, though the insects occur also on the underside of the foliage. The injury is especially marked on the lower limbs of large trees and on small trees and is practically confined to hard maple. The bluish-green moth with a wing spread of about ⅓ inch flies during May and deposits her eggs in tiny pear-shaped pockets in the leaves just beneath the lower epidermis.

The caterpillars become full grown in early fall, drop with the leaves and hibernate within their cases, consequently the raking and burning of the leaves in infested areas would destroy most of the insects. Spraying with poison in early June should also prove effective.

REFERENCES

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, p. 541.
1912, Felt, E. P., N. Y. State Mus. Bull. 155, pp. 56–59.

FIG. 126.—Maple leaf-cutter, adult and work, former enlarged.

1922, Herrick, G. W., Econ. Ent. Journ. 15:282–288.
1923, Herrick, G. W., C. U. Agr. Exp. Sta. Bull. 417, pp. 1–15.

Birch Leaf-Skeletonizer

Bucculatrix canadensisella Chamb.

In early fall skeletonized or browned white birch leaves, especially if bearing circular whitish cocoons, have been injured by the small pale green caterpillars of this pest.

This native species is widely distributed and occasionally becomes excessively abundant, as in 1901 and again in 1922. It feeds by preference on the common gray birch, though when numerous it may occur upon practically all birches. The full-grown caterpillars are pale green and less than 1/4 inch long. The larvæ appear the latter part of August or in early September and feed on the softer parts of the leaf, skeletonizing it thoroughly. At this time they spin upon the leaves small, circular, whitish, false cocoons about 1/8 inch in diameter. The true cocoons are brownish-yellow ribbed structures about 1/5 inch long, attached to the twigs, and provide winter shelter for the insect.

Control measures are impracticable under ordinary conditions, although lawn trees are easily protected by spraying from the middle to the latter part of August with an arsenical poison.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 315–317.

Yellow-Spotted Willow Slug

Pteronus ventralis Say

Greenish-black sawfly larvæ or false caterpillars about 1/2 inch long and with heart-shaped yellowish spots on each side defoliate willow and poplar.

This species (Fig. 127) is one of the worst enemies of basket willows in the South on account of its producing several generations annually. All varieties are liable to injury, except possibly the weeping willow. The greatest injury occurs on young growth and consequently arsenical poisoning is possible when advisable. The first signs of infestation are the blister-like swellings containing eggs on the upper surface

Fig. 127.—Yellow-spotted willow slug, adult, larvæ, cocoon and work.

of the foliage. The young slugs eat small holes in the leaves and usually feed near each other, though hardly gregarious. Growth is completed in ten days to three weeks. The full-grown caterpillars are slaty black with lighter spots on the sides. The final transformations occur in dark-brown cocoons on or near the surface of the ground.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 322–324.

Spotted Willow Leaf-Beetle

Lina lapponica Linn.

A reddish black-spotted beetle about 1/4 inch long feeds during the summer on willow leaves.

This close ally of the striped cottonwood beetle, *L. scripta* Fabr., (see page 96), has practically the same habits, the larvæ being indistinguishable. Some seasons it is just as abundant as the better known cottonwood leaf-beetle.

A related species, *Lina tremulæ* Fabr., easily distinguished by the greenish head and thorax and the brownish finely punctured wing-covers, is exceedingly abundant and injurious to willows in the northwestern states. It also attacks poplars. Both of these insects can be controlled by poison sprays.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 564–565.

Alder Flea-Beetle

Haltica bimarginata Say

Bluish rounded flea-beetles 1/5 inch long or dark brown, black-headed, black-tubercled grubs are frequently abundant on alder leaves.

This species is sometimes exceedingly numerous in the Adirondacks, the combined work of the active jumping beetles and the rather sluggish grubs resulting in the skeletonizing of the foliage in July and later. The insect appears to be widely distributed. The grubs attain maturity in August or September, construct rude cells in the leaf-mold an inch or so below the surface, the beetles issuing about two weeks later, feeding for a time on the leaves and then hibernating, issuing when alder leaves are well expanded. This flea-beetle is also recorded on willow, cottonwood and poplar on the Pacific Coast.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 573–574.
1917, Woods, W. C., Maine Agr. Exp. Sta. Bull. 265, pp. 249–284.

CHAPTER XII

NUT WEEVILS AND NUT WORMS

The nut-trees of the country are subject to attack by a number of insects and, since the problems in relation thereto are similar, they are discussed under a common heading. Many nuts attacked by insects drop early or before the depredator escapes, and one very effective though somewhat laborious control measure is to collect and destroy all such nuts before the pests enter the soil. This is particularly true of the nut weevils.

Nut Weevils and Nut Worms, List of Hosts and Species

Acorn
Balaninus baculi Chittn.
Balaninus confusor Ham.
Balaninus nasicus Say.
Balaninus orthorhynchus Chittn.
Balaninus quercus Horn.

Black walnut
Conotrachelus retentus Say.

Butternut
Conotrachelus juglandis Lec.

Chestnut
Balaninus proboscideus Fabr.
Balaninus rectus Say.

Hazel
Balaninus obtusus Bland.

Hickory
Balaninus caryæ Horn.
Conotrachelus affinis Boh.
Conotrachelus aratus Germ.

Pecan
Acrobasis hebescella Hulst.
Acrobasis caryivorella Rag.
Laspeyresia caryana Fitch.
Walnut
Carpocapsa pomonella Linn.

Chestnut Weevils

Balaninus proboscideus Fabr. and *B. rectus* Say

The weevils (Fig. 128), as well as closely related species, are noteworthy because of the very long proboscis or beak. Both are brown, the larger almost ½ inch long, the female with a beak 1¼ times to twice the body length, while the smaller has a length of ⅙ to ⅓ inch, the beak being longer than the body. The weevils appear about the time the chestnuts bloom and oviposit in the young burrs. The long snout of the female is well adapted for piercing the kernel and one or more eggs are then deposited. The slight injury to the husk and nut soon heals and there is no exterior indication of the insect's presence. The holes seen in wormy chestnuts are made by the grubs when they leave for pupation in the soil. Most of these weevils transform to adults the following season, although a delay to the second year is quite common. The smaller chestnut weevil breeds also in Chinquapin nuts and acorns.

Fig. 128.—Chestnut weevils and infested nuts.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 585–588.
1910, Brooks, F. E., W. Va. Agr. Exp. Sta. Bull. 128, pp. 157–162.

Hickory-Nut Weevil

Balaninus caryæ Horn

This is a very serious enemy of pecans, the loss in some of the southern states amounting to 75 per cent of the crop in certain years. The brownish weevil is about 1/3 inch long and similar in appearance to the chestnut weevils. The beetles appear on the trees in July in West Virginia and oviposition occurs in August and September, and farther south development may be about a month later. The grubs leave the infested nuts and presumably transform in the soil. Fumigation of infested nuts as for chestnut weevils has been recommended.

References

1910, Brooks, F. E., W. Va. Agr. Exp. Sta. Bull. 128, pp. 162–165
1917, Gill, J. B., U. S. Farmers' Bull. 843, pp. 13–16.

Hazel-Nut Weevil

Balaninus obtusus Blanch.

This species is very similiar to the weevils that attack chestnut. It is 1/4 to 1/3 inch long, very similar in color and may be distinguished from them by its shorter more robust form and very much shorter beak. The female is about 1/2 inch long and the beak is about one-half as long as the body. The beetles are abroad from about June 20th to July 15th, and the last of August infested nuts drop and the grubs escape from them.

Reference

1910, Brooks, F. E., W. Va. Agr. Exp. Sta. Bull. 128, pp. 165–168.

Acorn Weevils

Balaninus quercus Horn, *B. nasicus* Say, *B. orthorhynchus* Chittn., *B. baculi* Chittn. and *B. confusor* Ham.

It will be seen that there are at least five similar weevils attacking oaks, a condition not surprising when one remembers the numerous species of oaks, since there is frequently a parallel development between host and insect. Those particularly interested in the habits and biology of these species are referred to the account by F. E. Brooks in the West Virginia Agricultural Experiment Station Bulletin 128, pages 168–175, 1910.

Butternut Curculio

Conotrachelus juglandis Lec.

Numerous small nuts on the ground in July under black and white walnut trees are likely to show the crescent-shaped scars of this insect (Fig. 129), a close relative of the plum curculio. It is about ¼ inch in length, reddish-brown and prettily ornamented with golden and silvery hairs. It has also been recorded from various species of hickory. The first eggs are deposited in young black walnuts about June 10th to 15th and oviposition continues for more than a month, the walnuts being nearly half grown before the beetles have completed their task and toward the last the husk is so solid that only hollow pits are made instead of larger excavations. The nuts drop after the grubs have fed for about ten days or two weeks. The larvæ complete their growth in one or two weeks thereafter, enter the ground and soon pupate in earthen cells. The beetles issue during August and September, hibernate and reappear soon after the blossoms have dropped from the trees.

Fig. 129.—Butternut curculio, enlarged.

References

1906. Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 581–582.
1910. Brooks, F. E., W. Va. Agr. Exp. Sta. Bull. 128, pp. 176–177.
1922, Brooks, F. E., U. S. Dept. Agr. Bull. 1066, pp. 2–7.

Black Walnut Curculio

Conotrachelus retentus Say

Numerous young black walnuts on the ground in June are likely to have the crescent-shaped scars of this pale reddish weevil about ¼ inch long and covered with a grayish pubescence. It appears to be a common pest of young black walnuts in the eastern United States. Occasionally the grubs burrow in tender shoots of black walnut. Oviposition normally begins after the female catkins on the points of the nuts are beginning to wither, in West Virginia the last of May and continues through June and most of July. The newly developed beetles issue in August, and in late summer and early fall they may be found on the host tree, apparently feeding on leaf-petioles. They reappear in the spring when the male catkins are fully developed.

Reference

1922, Brooks, F. E., U. S. Dept. Agr. Bull. 1066, pp. 7–11.

Hickory-Nut Curculio

Conotrachelus affinis Boh.

This species is very similar to the two preceding except that it attacks immature nuts of various kinds of hickory instead of walnuts. The beetles appear on the trees somewhat later in the spring than the other two and lay their first eggs in hickory-nuts that are at least half grown. The most conspicuous evidence of infestation is the dropping of many nuts in July and August, each bearing a circular or somewhat crescent-shaped oviposition scar. The insect appears to develop much later in New York state, since grubs provisionally identified as those of this species were leaving the nuts in mid-October. The grubs desert the nuts some ten days or two weeks after they have fallen to the ground, and the young beetles appear from about the middle of August to the middle of October. Oviposition in West Virginia begins late in June and extends over a period of four weeks.

References

1910, Brooks, F. E., W. Va. Agr. Exp. Sta. Bull. 128, pp. 178–179.
1922, Brooks, F. E., U. S. Dept. Agr. Bull. 1066, pp. 11–14.

Walnut Husk-Maggot

Rhagoletis suavis Lw.

The work of this insect in the nuts of black walnut is indicated by the blackened hulls which are slimy within and contain numerous whitish maggots which move freely through the soft pulp. Such nuts are disagreeable to handle and in hulling the husk sticks to the inner shell and leaves it dirty and unattractive. The parent fly is dark and yellowish with brown-banded wings and about the size of the housefly. It appears on walnut trees at the time nuts are maturing and lays clusters of eggs in the husk of the nuts. These soon hatch and the maggots destroy the green tissues. There is but one generation annually. Spraying in early August with arsenate of lead, three pounds to fifty gallons of water, has given considerable protection.

Reference

1921, Brooks, F. E., U. S. Dept. Agr. Bull. 992, pp. 1–8.

Hickory Curculio

Conotrachelus aratus Germ.

This insect disfigures the tender tips and leaf-petioles of hickory with dark V-shaped galleries $\frac{1}{8}$ inch long soon after growth begins in the spring. These may occur in series of five to ten along the shoot, one above each leaf-axil. The pale grayish-brown curculio, with a more or less indistinct broad band of yellowish pubescence behind the middle of the elytra and a narrow line of the same color on each side of the thorax, is less than $\frac{1}{4}$ inch long and $\frac{1}{12}$ inch wide. The beetles issue from the ground in midsummer and probably remain comparatively inactive before hibernating. They reappear as soon as the hickory shoots are a few inches long, feed freely for a time and deposit eggs as described above.

Reference

1922, Brooks, F. E., U. S. Dept. Agr. Bull. 1066, pp. 14–16.

Pecan Nut Case-Bearers

Acrobasis hebescella Hulst and *A. caryivorella* Rag.

Nuts the size of garden peas may be webbed together by dark olive-green caterpillars not over $\frac{1}{2}$ inch long belonging to one of the above-mentioned species and inhabiting short silk-lined tubes. This insect is very destructive in the southern states and not infrequently the injury is attributed to frost instead of the true cause. The parent insect is a grayish-black moth with a wing spread of about $\frac{3}{4}$ inch. There are three generations annually, the over-wintering larvæ attacking young and tender shoots in the spring. The eggs from the first generation moths, which appear from May 7th to 24th, are laid on the calyx end of the nut and the young caterpillars soon bore into them as described above. The second generation moths appear from the middle of June to the first week of July, and those of the third generation during the first three weeks in August. It is the larvæ from the first generation moths which cause most of the injury.

Experiments have shown a very considerable degree of protection resulting from spraying with arsenate of lead at the rate of three pounds to fifty gallons of water, making the first treatment at about the time the earliest moths appear and the second two weeks later. A third application was given the last of June for the purpose of destroying second brood larvæ.

REFERENCES

1917, Gill, J. B., U. S. Farmers' Bull. 843, pp. 3–9.
1918, Turner, W. F., Ga. State Bd. Ent. Bull. 49, pp. 14–19.
1918, Matz, J., Fla. Agr. Exp. Sta. Bull. 147, p. 152.
1921, Bilsing, S. W., Journ. Econ. Ent. 14:149–153.

PECAN SHUCKWORM

Laspeyresia caryana Fitch

The whitish caterpillars of this insect, 3/8 inch long when full grown, burrow in the outer shucks or husks and prevent the development of the young nuts and injure larger ones so that they may contain only shrivelled kernels. There are probably one to three generations, the moths beginning to appear in northern Florida as early as mid-February and continuing to emerge until the latter part of April, most of them issuing before the appearance of pecan foliage and nuts. The first brood of larvæ feed mostly on small hickory-nuts, penetrating to the center and causing early dropping. The last brood confines its operations to mining in the shucks and winters therein. This habit suggests that systematic collecting and destroying of shucks will result in a considerable reduction in the numbers of this pest.

REFERENCES

1916, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, p. 583.
1917, Gill, J. B., U. S. Farmers' Bull. 843, pp. 9–13.
1918, Turner, W. F., Ga. State Bd. Ent. Bull. 49, pp. 22–23.
1918, Matz, J., Fla. Agr. Exp. Sta. Bull. 147, pp. 153–154.

CODLIN-MOTH

Carpocapsa pomonella Linn.

It has been demonstrated conclusively in recent years that this common apple pest is a serious enemy of walnuts on the

Pacific Coast. The eggs are first found on the young walnuts about the middle of May and a large proportion of the young larvæ enter or attempt to enter at the calyx end of the nut, although toward the last of June the nut becomes too hard and the young larvæ then frequently enter where two nuts are in contact. Pupation of the first brood of larvæ occurs from the middle of June until the last half of July, the latter being the preferred period. Transformation to the moths occur from the last of June through to September, the maximum being the very last of July. Eggs of the second brood may be found from early July into August, the heaviest deposition occurring the first week in August. Timely application of arsenate of lead has resulted in very satisfactory control.

Reference

1921, Quayle, H. J., Journ. Econ. Ent. 14:440–444, and vol. 15, pp. 371–372.

Control Measures for Nut Weevils

The nut industry of the country is rapidly increasing in importance with the probability that the relatively few commercial orchards of the present may be increased greatly in the future. The higher prices of nuts in recent years justify measures which earlier were impracticable on account of the relatively great cost. Little effective control can be hoped for on miscellaneous trees, which latter would serve as breeding centers for reinfestation.

A number of the nut weevils at least feed on the foliage to a greater or less extent and this habit makes arsenical poisoning a possibility. Britton and Kirk have found that applications of lead arsenate at the strength of six pounds to fifty gallons of water is an effective method of controlling the walnut curculio and another case is on record of very effective control of the butternut curculio.

Fumigation of recently gathered nuts for a period from twelve to twenty-four hours with bisulfide of carbon, using half an ounce for each bushel, has been recommended for nut weevils by various authorities and is advisable as in most cases it destroys most of the grubs at once and at least prevents further injury and also aids somewhat in reducing the crop of weevils likely to attack the trees the next season. Infested chestnuts are easily separated, since they are lighter than water and float and these should be fed to hogs or destroyed before there is an opportunity for the worms to escape.

References

1912, Britton, W. E., and Kirk, H. B., 12th Rept. of Conn. State Ent., pp. 248–249.

1919, Morris, Robert T., Amer. Nut Journ., vol. 10, No. 5, p. 71.

CHAPTER XIII

CONIFEROUS FOREST TREE BORERS

(Bark and Timber Beetles Excepted)

Coniferous trees have a somewhat peculiar fauna and practical considerations make it advisable to distinguish between insects attacking these trees and those affecting the deciduous species, although there are some insects which occur in both classes.

The coniferous forests suffer mostly from the attack of borers, particularly the bark-borers, although the larch sawfly, the pine butterfly and the spruce bud-worm are marked exceptions in their extensive defoliations, injuries which are frequently followed by bark-beetle invasions.

Key to Borers and Insects Attacking Wood or Bark

Pines
- Wilting, browning or dead leaders in midsummer, also in spruce.
  - White pine weevil, *Pissodes strobi* Peck, p. 227.
- Seedlings may have the bark badly gnawed or scored.
  - Pales weevil, *Hylobius pales* Boh., p. 229.
- Wilting or browning of portions of the tips of shoots or granular pitch masses.
  - Pitch twig moth, *Evetria comstockiana* Fern., p. 230.
  - Pine-tip moth, *Pinipestis zimmermanni* Grote, p. 230.
  - European pine-shoot moth, *Evetria buoliana* Shiff., p. 231.
- Yellowish-orange maggots in pitch exudations or pine needles.
  - Pitch midges, *Retinodiplosis* spp., p. 232.
- Large brownish pitch masses on pine trunks.
  - Pitch-mass borer, *Parharmonia pini* Kell., p. 233.
- Ants boring in trees or injuring young seedlings.
  - Carpenter ant, *Camponotus herculeanus* Linn., p. 234.
  - Mound ant, *Formica exsectoides* Forel, p. 234.

Large, white, fleshy, legless grubs in inner bark, sapwood and heartwood.
Sawyer, *Monochamus confusor* Kir., p. 235.
Broad-headed flattened grubs under the bark of dead trees.
Ribbed pine borer, *Rhagium lineatum* Oliv., p. 237.
Hemlock
Flattened sinuous galleries in the inner bark of living or dying trees
Spotted hemlock borer, *Melanophila fulvoguttata* Harr., p. 238.

White Pine Weevil

Pissodes strobi Peck

Wilting, browning, dying or dead leaders in midsummer or later, usually on trees 3 to 15 feet high, are characteristic signs of this insect's work (Fig. 130).

The cause of this difficulty is a small, reddish-brown, irregularly whitish marked weevil about 1/4 inch long. The weevils winter in any shelter and attack trees from early in the spring, remaining in greater or less numbers throughout the summer and may even survive a second winter and continue their work another season. The eggs are deposited here and there along the leaders and the small stout white grubs or motionless pupæ may be found under the bark in galleries or cells from the last of May to the latter part of July and even until early September. This insect seriously injures young pine plantings, especially in regions where scattering pines promote a general infestation. It also attacks spruce, occasionally causing considerable damage.

Peirson recommends moderately thick planting with the expectancy that the loss from this insect will not exceed 10 per cent, many of the trees recovering if the planting is thick enough to force leader growth. He finds less likelihood of injury in mixed plantings, providing the growth is moderately thick. Recent work by Blackman of the New York State College of Forestry suggests that considerable protection can be secured by inter-planting Scotch and white pines, the rows being at right angles to the prevailing winds of spring and early summer. The more rapid early growth of Scotch pine protects the white pine to a large extent. The Scotch pines, when 20 to 30 feet high, may be cut out for box boards or other cheap lumber.

Fig. 130.—White pine weevil, much enlarged, work natural size.

Owners of extensive plantings of young pines may accomplish much by cutting out and burning infested shoots in the first half of July and placing them in a barrel with the opened end closely covered with ordinary wire mosquito netting, thus allowing beneficial parasites to escape and preventing the weevils gaining access to other trees.

A direct and positive method of protecting recently set trees is systematically to collect the beetles, beginning in early spring and repeating at three to five day intervals until practically no weevils are captured. An ordinary insect net may be used, held beside and a little below the shoots and the leaders tapped lightly with a stick so that the insects drop into the net. The collected weevils may be killed by emptying them into a little kerosene and water. Small individual trees on lawns may be protected for a period in early spring, the time when injury is most likely to occur, by putting white mosquito netting over the trees. The covering should not be left on more than a few weeks.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 397–401.
1915, Felt, E. P., N. Y. State Mus. Bull. 175, pp. 30–33.
1922, Peirson, H. B., Harvard Forest Bull. 5, pp. 1–42.

Pales Weevil

Hylobius pales Boh.

Young conifers may have the bark badly gnawed or scored, especially in recently cut pine trees.

This weevil (Fig. 131) is frequently in association with the much better known and more destructive white pine weevil. It is a rather heavy, dark reddish-brown to black beetle about ⅓ inch long, with the wing-covers ornamented with tufts of rather long gray or yellowish hairs. The weevils appear the latter part of April or during May and immediately begin feeding. They are attracted to white pine logs or stumps in which they deposit eggs, the grubs developing in much the same way as those of the white pine weevil, the full-grown insects appearing the following September or October. The most serious damage to seedlings occurs at this season and is most prevalent in the vicinity of recently cut pine land.

Fig. 131.—Pales weevil, much enlarged.

Experience has indicated that it is unsafe to plant young pines during the first two seasons after cutting pine lands, or to plant them in the near vicinity of freshly cut logs or sawn lumber, since the beetles may be attracted in large numbers to these latter and are then likely to spread to and seriously injure near-by seedlings. When natural reproduction is desired, there should first be a thinning to stimulate pine reproduction, or if a clear cut is made the fall or winter following a heavy fall of seed, preliminary thinning is not necessary.

The slash should be burned in piles after cutting and the new crop on the cut-over area usually should be weeded twice, depending on the site.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, p. 664.
1921, Peirson, H. B., Harvard Forest Bull. 3, pp. 1–33.

Pine Twig-Borers

Wilting or browning portions of the tips of shoots or granular masses of pitch from galleries in the twigs are evidences of work of several small boring caterpillars.

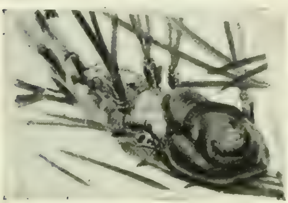

Fig. 132.—Pitch twig moth, work.

The native pitch twig moth (*Evetria comstockiana* Fern., Fig. 132) works in the smaller limbs and twigs of hard pine and builds up granular masses of pitch, covering the entrance to the burrow inhabited by a small, yellowish-white, brown-headed caterpillar about ½ inch long. The insect is injurious to individual limbs and occasionally causes rather marked damage. The caterpillars winter in their burrows, the moths appearing in early June. The eggs are presumably deposited on the twigs.

Fig. 133.—Pine-tip moth, work.

The pine-tip moth (*Pinipestis zimmermanni* Grote, Fig. 133) caterpillars work nearer the tips of the new shoots, dwarf the needles and build small tubes of pitch at the base of the injured part. The affected shoots soon turn brown. This species produces "spike top" in western pines, attacking mature trees from between 10 to 30 feet down from the top, and second growth from about breast high to a height of 35 to 40 feet, killing many trees.

The European pine-shoot moth (*Evetria buoliana* Shiff., Fig. 134) is a recent European introduction, which usually attacks several terminal buds and frequently produces the peculiar bayonet-shaped deformation figured. As many as six buds may be destroyed in one whorl. The early stages of infestation are indicated by a rather obscure exudation of pitch, frequently somewhat granular, at the base of the buds and within small, brown, black-headed caterpillars, the orange-colored irregularly silvery-lined moths issuing mostly during June. The eggs are laid on the terminal buds the latter part of July or in August. This species infests all kinds of European pines and is recorded as equally injurious to American pines.

Fig. 134. — European pine-shoot moth, work; note the blasted buds at the base of the shoot.

Shoots badly affected by any of these twig-borers may be cut out and burned, a practice which can be recommended only in ornamental plantings. In the West, badly infested or "brood trees" should be cut and burned, thus materially lessening infestation by the pine-tip moth.

References

1914, Busck, August, Econ. Ent. Journ. 7:340.
1915, Busck, August, U. S. Dept. Agr. Bull. 170, pp. 1–11.
1915, Brunner, Josef, U. S. Dept. Agr. Bull. 295, pp. 1–12.
1915, Felt, E. P., N. Y. State Mus. Bull. 180, pp. 39–42.

Pitch Midges
Retinodiplosis spp.

Yellowish-orange maggots with a distinct breast-bone live in pitch exudations of pine or infest the needles or twigs and occasionally cause material injury (Fig. 135).

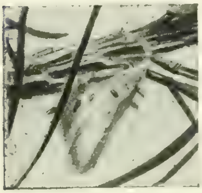

Fig. 135.—Pitch midge, work; note cast skins projecting from the pitch.

Small hard pines are sometimes in an unhealthy condition, due in part to an excessive flow of pitch and in certain cases pitch masses ½ inch in diameter or thereabouts may be found upon the branches, each containing a few to a number of yellowish maggots. The transformations occur within the pitch masses. This is the work of one of the earliest known pitch midges, *Retinodiplosis resinicola* Osten Sacken.

Another species produces obscure subcortical swellings in the smaller branches of the scrub pine, *Pinus rigida* and *P. virginiana*, the full-grown maggots issuing from the branches and undergoing their final transformations in small whitish oval cocoons upon the needles or the tips of the twigs. This species is *R. inopis* Osten Sacken.

Fig. 136.—Pine needle gall-fly, infested shoot.

A western form, *R. resinicoloides* Wlms., is found in California in the resinous exudations of the Monterey pine, *Pinus radiata,* and occasionally weakens trees to a considerable extent.

A fourth species, *R. palustris* Felt, was reared from pitch on twigs of the long-leafed pine collected in Alabama.

A somewhat abnormal species, *R. taxodii* Felt, has been reared from cones of the bald-cypress, *Taxodium distichum,* the larvæ living in galls which are evidently modified or aborted seeds.

The pine needle gall-fly, known as *Cecidomyia pini-rigidæ* Packard (Fig. 136), probably belongs to the genus Retinodiplosis and is especially interesting because of the subglobular basal swelling it produces in aborted pine needles, considerable groups on individual branches sometimes being affected.

References

1880, Comstock, J. H., U. S. Dept. Agr. Rept., 1879, pp. 256–257.
1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 410–413, 423–425.
1921, Felt, E. P., N. Y. State Mus. Bulls. 231–232, pp. 156–162.

Pitch-Mass Borer

Parharmonia pini Kellicott

Large brownish pitch masses on pine trunks are usually the work of this boring caterpillar.

The pitch caterpillar is rarely abundant enough to cause serious injury, although the masses of pitch are far from uncommon. The borer is peculiar in its ability to move freely through the semi-fluid pitch, and, despite its living in such a medium, it is subject to attack by parasites. The tree is usually invaded somewhere just below a branch or near the border of a wound made by an axe or other agency. Large trees are very liable to attack. Pupæ occur the last of May and the moths appear from the middle to the end of June. This insect is allied to the troublesome squash vine-borer of the garden. No practical control measures are known.

Reference

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 341–342.

Ants and Trees

A great many ants are observed on and about trees and some at least are known to be directly injurious. A number of species of ants protect plant-lice, the young of tree-hoppers, and the like, and probably cause a considerable amount of mischief by producing conditions favorable to an enormous development of these minute insects.

The large black carpenter ant, *Camponotus herculeanus* Linn. (Fig. 137), is the common timber ant of dwellings and forests. Occasionally it becomes so abundant in houses as to prove a veritable nuisance on account of forays in the pantry and in not a few instances it may weaken a dwelling structurally by excavating large irregular galleries in timbers. It is not at all uncommon to find balsam trees in the Adirondacks which have broken over because this species gained an entrance to the trunk and ate away most of the interior. The excavations in balsam are beautifully regular and determined in large measure by the alternations of somewhat hard and softer wood due to different periods of growth, whereas the work of the same insect in elm is extremely irregular, as the interlacing fibers present almost equal difficulties to the insect working in any direction.

Fig. 137.—Carpenter ant, work in poplar, reduced.

The mound ant, *Formica exsectoides* Forel, constructs nests in rather open woodland areas and the investigations of H. B. Peirson have shown that these ants destroy young pine trees by tearing away the epidermis and ejecting formic acid on the exposed delicate tissues. This coagulates the cell contents, prevents the downward flow of sap and thus kills the trees. It is possible only in the cases of small trees; is somewhat general in some areas and apparently occurs only when the trees shade the ant nests too much.

Ant control is usually directed toward locating the nest and killing the insects with carbon bisulfide, using a pint or so for a good-sized nest and facilitating its entrance by punching several holes, pouring the insecticide in and then preventing its escape by covering the nest and fumigant either with a large pan, blanket or other material so as to hinder evaporation. Carpenter ants in houses presumably can be destroyed most easily by the use of a diluted, sweetened, arsenical preparation, since the nests of this species are usually inaccessible.

References

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, p. 90.

1922, Peirson, H. B., Journ. of Forestry, 20:325–336.

Fig. 138.—Sawyer.

Sawyer

Monochamus confusor Kirby

Large, white, fleshy, legless grubs from 1½ to 2 inches long frequently work in the inner bark, sapwood and heartwood of dying pines, spruces and balsams (Figs. 138, 139).

The sawyer is one of the largest and most common borers under the bark of logs and dead and dying coniferous trees. Its presence may be detected easily by the masses of coarse, white sawdust-like borings, which frequently collect on the ground or may be found under the bark. The magnificent grayish beetles have a body length of ¾ to 1½ inches and antennæ which may measure from 2 to 3 inches additional. They are abroad in midsummer and are usually found on dying or sickly trees. This insect frequently follows attack by bark-borers. The eggs are deposited in gashes cut in the

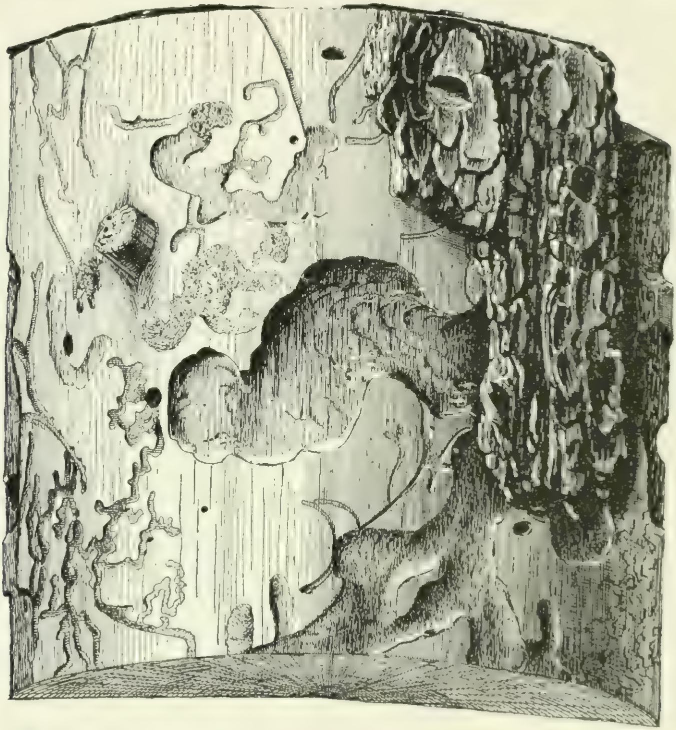

Fig. 139.—Sawyer, work in pine, note oval oviposition scar, circular exit hole and broad, irregular galleries; the smaller galleries are the work of bark-beetles, about half natural size.

bark. The young grubs work mostly in the inner bark, the older ones penetrating the sapwood and even traversing the heart of the tree. The life cycle may be completed in one year, although some believe it extends over two seasons.

There are several closely related and very similar appearing species, namely, *M. scutellatus* Say, *M. titillator* Fabr. and *M. marmoratus* Kirby. These latter are smaller, though they have practically identical habits with the first named. These insects and ambrosia beetles are very injurious to timber.

Logs of pine and spruce carried over a season should, if possible, be placed in water as soon as the ice is gone. If they are in a loose boom so there is considerable drift and the tops of the logs are therefore wet, no further attention is necessary; otherwise they should be turned about a month after they have been floated. Logs left in the woods may be protected by barking them before the middle of July and, if this be too expensive, fairly good results may be secured by piling them on skidways and thickly covering them with green spruce, pine or balsam boughs, the spruce being the best. Recent investigations have shown that many bark-borers are destroyed in logs left exposed to the sun. Consequently if those in the open are turned, provided the bark is not too thick, there is less likelihood of their being seriously damaged.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 360–366.

1917, Swaine, J. M., Ent. Soc. Ont. 47th Rept., pp. 96–97.

Fig. 140.—Ribbed pine borer, enlarged.

Ribbed Pine Borer

Rhagium lineatum Olivier

A white, broad-headed, flattened grub is frequently under the bark of dead trees (Figs. 140, 141).

The grubs of this grayish, black mottled, stout beetle about ½ inch long are very common in partly rotten pine bark. They are easily recognized by the peculiar pupal cell some

¾ inch in diameter, partly lined with somewhat decayed wood particles, though most of the cell is composed of splinters torn from the wood at the bottom of the cell. The grub ranges in length from ¾ to 1¼ inches and is remarkable for its broad amber-colored head which is fully as wide as the thoracic segments. Both grubs and beetles winter under the bark.

A smaller more slender grub is frequently found with Rhagium. It constructs a nearly circular pupal cell about

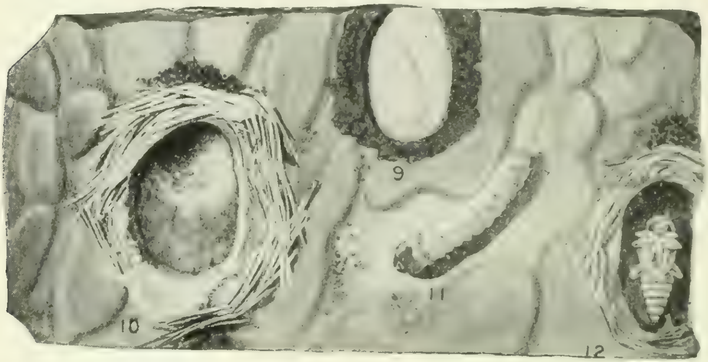

Fig. 141.—Ribbed pine borer, larva, pupa and pupal cells, the dark cell (9) that of the associated Pytho.

¾ inch in diameter and is easily recognized by the fact that the walls are entirely composed of partly rotted borings. The beetle, *Pytho americanus* Kirby, is about ½ inch long, black except for the dark bluish-green striated wing-covers. Neither of these species is especially injurious.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 366–369.

Spotted Hemlock Borer

Melanophila fulvoguttata Harris

Numerous flattened sinuous galleries in the inner bark of living or dying trees may contain the slender whitish grubs about ½ inch long of this borer (Figs. 142, 143).

The flattened dark metallic colored beetle less than $\frac{1}{2}$ inch long with grayish reflections and six circular, yellowish or whitish spots on the wing-covers is responsible for serious injury to hemlocks. It is credited by Burke with having caused the death of a large amount of hemlock timber throughout the Appalachian and northeastern states and in 1913 it was the active agent in destroying a number of magnificent trees within the limits of New York City. Infestation by this insect may be so severe as to result in 127 beetles and 72 parasites being reared from a log $2\frac{1}{2}$ feet long and 12 inches in diameter. The trunks of infested trees under such conditions are fairly girdled with the innumerable, interlacing, sinuous, flattened galleries. The beetle is mostly a midsummer species, being abroad in June and July. The eggs are evidently laid in crevices of the bark, sometimes in pairs. The older grubs excavate broad and irregular partly frass-filled burrows which very effectively

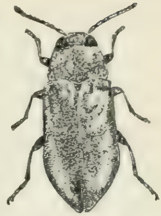

FIG. 142.—Spotted hemlock borer, enlarged.

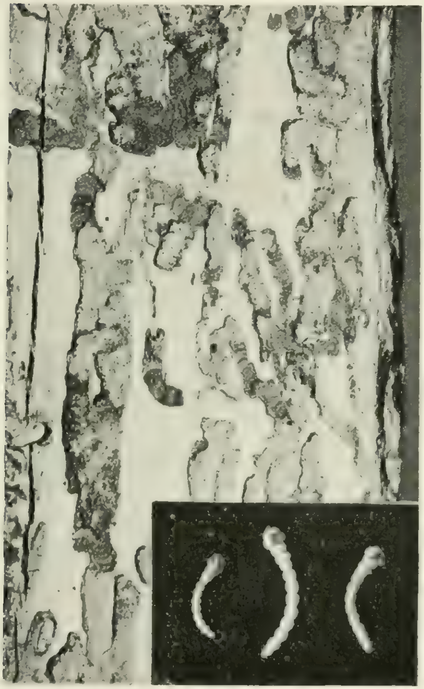

FIG. 143.—Spotted hemlock borer, work and grubs.

girdle the tree. The species is recorded as occurring throughout the middle and the northern part of the United States.

The most effective control measure is to cut out all dead or sickly trees and burn the thicker bark at least during the winter or early in the spring. Hemlocks injured by fire or wind storms after April 1st may well be left as trap trees and removed the following spring.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 390–391.
1915, Felt, E. P., N. Y. State Mus. Bull. 175, pp. 26–30.

CHAPTER XIV

BARK-BEETLES AND AMBROSIA OR TIMBER BEETLES ATTACKING CONIFERS

A NUMBER of bark-beetles are among the most injurious insect pests of coniferous trees and to a certain extent of some other trees. All lumbermen and many others are accustomed to associate the dying of trees over extensive areas with various fires. There is no question but that fires have been responsible for enormous losses, yet the investigations of Hopkins have brought forth very conclusive evidence that some of the large denuded areas in the Rocky Mountains supposed to have been caused by forest fires were primarily the work of one or more species of bark-beetles belonging to the genus Dendroctonus. The studies of Hopkins lead him to place the stumpage value of timber destroyed by these insects in the United States during the past fifty years at more than one billion dollars.

A few specific cases will illustrate conditions resulting from bark-beetle attack. The work of the spruce-destroying beetle, *Dendroctonus piceaperda* Hopk., was observed by the late C. H. Peck in the Adirondacks from 1874 to 1876 and, in commenting on conditions in the latter year, he states that there is reason to believe that much of the spruce timber in Hamilton County had already been invaded by the beetle. This insect is credited with destroying a very large percentage of the mature spruce over thousands of square miles of forests. There was wide-spread and serious injury to pines in the southeastern United States by the southern pine bark-beetle, *Dendroctonus frontalis* Zimm., from about 1880 till 1892, the damage being general over thousands of acres in five states and in some areas including nearly all pines. The spruce-destroying beetle was again active in northern New England, particularly Maine, in 1900, the large amount of dead spruce in the upper Androscoggin attracting especial attention, the affected trees occurring individually or in clumps of a few to several hundred scattered through the forest or left in the cutting, the best stands and largest timber being affected irrespective of soil, exposure or altitude. The Black Hills beetle, *Dendroctonus ponderosæ* Hopk., is credited in 1909 by its describer with having killed more than a billion feet of timber in the Black Hills forest reserve and also with being injurious in central Colorado and New Mexico, attacking western yellow pine and white spruce. The western pine-destroying bark-beetle, *Dendroctonus brevicomis* Lec., was responsible, in the opinion of Hopkins, for the death in 1905 of 2 to 5 per cent of the matured standing bull pine timber in the section of Idaho investigated that season. During the last twenty years a very different bark-beetle, the hickory bark-borer, *Scolytus quadrispinosus* Say, has caused the death of many thousands of magnificent hickory trees in the north-eastern United States. Hopkins estimates the loss caused by forest insects at a considerably higher figure than that resulting from forest fires.

All of these beetles attack the trees in swarms. They enter the bark of the trunk, frequently about midway of the height of the tree and excavate their egg galleries for a greater or less distance, the eggs being deposited in minute notches on either side. This weakens the tree and greatly increased damage results from the galleries, usually more or less transverse, of the young as they work away from the tunnel of the parent insect. A general infestation speedily results in the girdling of the trees and their death, due to the fact that the galleries are made in the inner bark and outer sapwood.

The earliest signs of infestation are limited to particles of brown or whitish borings in the bark crevices accompanied sometimes by more or less exudation of resin or sap. Some of the pine bark-beetles use the exuding pitch for the construction of conspicuous pitch tubes around the entrance to their galleries. These pitch tubes and accumulations of pitch in the galleries, especially the latter, remain for years and are conclusive evidence of trees having been attacked while alive. Trees showing numerous circular holes in the bark appearing as though they had been caused by buck-shot have been deserted by the bark-beetles and have, therefore, ceased to be a menace to the adjacent forest. Control measures designed to destroy insects in trees and thus protect other areas must be carried out before the beetles have had an opportunity to escape, which usually means some time before warm weather of the spring following attack.

The bark-beetles are small, cylindrical, stout, dark brown or black insects rarely ½ inch long and usually ¼ inch long or less. They resemble each other closely and are not easily identified by themselves. Fortunately the work of many species differs markedly from that of others and the type of gallery in connection with the name of the host tree makes it comparatively easy to identify the more common species. Furthermore, the general similarity of habit and the fact that preventive or control measures are about the same for most species, makes the question of specific identity somewhat less important so far as the lumberman is concerned, although it may be decidedly advantageous to be able to distinguish between the work of beetles likely to increase greatly and become very injurious and those which are rarely able to do more than maintain themselves in small numbers.

Certain bark-beetles breed freely in healthy trees and others thrive in those with a reduced vitality. Moreover, conditions which result in a great production of bark-beetles may be followed by unusual injury, since to a certain extent the ability of the beetles to enter and kill a tree is matched against the resistance of the host. It is obviously impossible under present forest conditions to practice many direct control measures, although a recognition of the conditions favorable to injury may indicate precautions which may be carried out to a greater or less extent and result in a considerable mitigation of the danger.

In the first place, it is well recognized that bark-beetles thrive in recently cut or killed trees or parts of trees, consequently general logging operations, which result in the leaving of large quantities of slash, are a potential danger, because of the possibility of beetles breeding in this material and then spreading to adjacent woodlands. Practical modifications of logging, which will reduce slash to a minimum, are therefore very desirable.

It is also known that trees partly killed by fire are attractive to bark-beetles and enormous reproduction in such material is a positive menace to adjacent areas. The early cutting and marketing of lumber and wood from such tracts means not only salvage of present resources but protection to near-by forests.

The extensive defoliation of woodlands by any of the leaf-eating insects means reduced vitality and the starting of natural processes which may result in invasion by various borers, their multiplying in large numbers in such areas and then spreading to healthy trees.

It should be noted that practically all of the more destructive bark-bettles show a decided preference for the larger, more matured trees, the younger timber being attacked later. It obviously follows that the older timber should be removed first in areas in which there is danger of bark-borer injury.

Bark-beetles are subject to attack by a number of natural enemies. Various species of woodpeckers are among the more efficient and it is not uncommon to find trees which were badly infested practically free of the insects as a result of the activities of these birds. Also a number of parasitic insects and predaceous species commonly attack bark-beetles and are, therefore, decidedly beneficial. Unfortunately, there are no very practical methods of increasing the activities of these natural enemies.

Systematic cutting year after year provides conditions attractive to bark-beetles and may actually result in protection to adjacent areas, whereas sporadic cutting here and there may produce conditions favorable for the enormous multiplication of bark-beetles in one season and their being compelled to attack living trees the next because nothing suitable can be found in the vicinity.

Ordinarily winter cutting is the safer procedure, since bark-beetles may be attracted in large numbers to trees felled in midsummer. Winter cutting, especially in areas injured by bark-beetles, and the early disposal of the lumber would do much to reduce the probability of injury another season. The investigations of Hopkins have shown that it is not necessary to remove all of the infested timber and that in some instances a reduction of 75 per cent is sufficient to prevent serious injury. It is very probable that systematic work along these lines continued over extensive areas would bring about a gratifying reduction in the numbers of bark-beetles.

Experience has demonstrated the utility of the methods outlined above. A most striking example occurred in 1907 when some 65,000 feet of timber on an Idaho estate were infested by the Black Hills beetles with the probability of their issuing in large numbers and attacking considerably more timber. The owner was advised of the situation but no action was taken and at the end of the season the infestation had spread to such an extent as to involve 250,000 feet. This was cut out and the owner reported later that the outcome was entirely satisfactory, the operation resulting in a net profit of about $5 a thousand feet on the logs at the mill.

The cutting alone of infested timber is not sufficient to prevent the breeding out of the insects and their spread to other trees the following season. Slab-wood with the bark badly infested by borers should be burned before spring has advanced, and saw-logs which can not be worked up prior to warm weather should be immersed in water and if there is more or less wave action no other precaution is necessary; otherwise they should be turned several weeks after they have been put in the water in order to drown all the borers. The infested bark of branches and trunks and slash should be burned so far as possible. Well directed and general work along this line will do much to bring bark-beetle prevalence below the danger point. This has been demonstrated in the forests of the western United States.

Bark-beetle infestations are spotty in character and may be recognized easily at a distance by the red tops of the affected trees and, on a closer examination, by the pale yellow or brown borings or sawdust and the grubs or borers in the inner bark and sapwood. The practical lumberman desirous of cutting the most from his holdings should give first attention so far as possible to injured trees, whether they have been damaged from one cause or another, because immediate cutting means securing most of the wood in the best possible condition under the circumstances, and with the proper handling of the slash this plan would result in the destruction of millions of insects which might otherwise spread and carry destruction to near-by trees.

Hosts of American Bark and Ambrosia or Timber Beetles[1]

Arbor-vitæ
Phlœosinus dentatus Say.

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[1] See Can. Ent. 54:128–134, 1922, for an extended list of western Ipids and hosts.

Ash
Leperisinus aculeatus Say.
Balsam
Crypturgus atomus Lec.
Dryocœtes pseudotsugæ Swaine.
Scolytus piceæ Swaine.
Pityokteines sparsus Lec.
Beech
Monarthrum mali Fitch.
Xyleborus xylographus Say.
Xyloterinus politus Say.
Birch
Dryocœtes betulæ Hopk.
Monarthrum mali Fitch.
Xyleborus xylographus Say.
Xyloterinus politus Say.
Cedar, red
Phlœosinus dentatus Say.
Cypress
Phlœosinus cristatus Lec.
Phlœosinus cupressi Hopk.
Xyleborus sacchari Hopk.
Dogwood
Pseudopityophthorus minutissimus Zimm.
Elm
Hylurgopinus rufipes Eich.
Fir
Scolytus piceæ Swaine
Fir, Douglas
Dendroctonus pseudotsugæ Hopk.
Dryocœtes pseudotsugæ Swaine.
Hemlock
Xyleborus xylographus Say.
Hickory
Chramesus hicoriæ Lec.
Scolytus quadrispinosus Say.
Xyleborus celsus Eich.
Xyleborus xylographus Say.
Larch
Dryocœtes americanus Hopk.
Dryocœtes autographus Ratz.
Gnathotrichus materiarius Fitch.
Ips pini Say.
Polygraphus rufipennis Kirby.

Larch, eastern
  Dendroctonus simplex Lec.
  Orthotomicus cœlatus Eich.
Larch, western
  Dendroctonus pseudotsugœ Hopk.
  Xyleborus xylographus Say.
Maple
  Xyleborus xylographus Say.
  Xyloterinus politus Say.
Oak
  Pseudopityophthorus minutissimus Zimm.
  Monarthrum mali Fitch.
  Xyleborus xylographus Say.
Pine
  Crypturgus atomus Lec.
  Dendroctonus mexicanus Hopk.
  Dendroctonus parallelocollis Chap.
  Dendroctonus terebrans Oliv.
  Dendroctonus valens Lec.
  Gnathotrichus materiarius Fitch.
  Orthotomicus cœlatus Eich.
  Pityophthorus spp.
  Polygraphus rufipennis Kirby.
  Monarthrum mali Fitch.
  Xyleborus xylographus Say.
Pine, hard
  Ips cacographus Lec.
Pine, Jeffrey
  Dendroctonus jeffreyi Hopk.
Pine, limber
  Dendroctonus ponderosœ Hopk.
Pine, lodge-pole
  Dendroctonus monticolœ Hopk.
  Dendroctonus murrayanœ Hopk.
  Dendroctonus ponderosœ Hopk.
Pine, Mexican white
  Dendroctonus ponderosœ Hopk.
Pine, silver or western white
  Dendroctonus monticolœ Hopk.
Pine, sugar
  Dendroctonus monticolœ Hopk.
Pine, western white
  Ips integer Eich.
Pine, western yellow
  Dendroctonus approximatus Dietz.

Dendroctonus arizonicus Hopk.
Dendroctonus barberi Hopk.
Dendroctonus brevicomis Lec.
Dendroctonus convexifrons Hopk.
Dendroctonus monticolæ Hopk.
Ips emarginatus Lec.
Ips integer Eich.
Ips oregoni Eich.

Pine, white
Dendroctonus rufipennis Kirby.
Dryocœtes americanus Hopk.
Dryocœtes autographus Ratz.
Ips calligraphus Germ.
Ips pini Say.
Pityokteines sparsus Lec.

Pine, yellow
Dendroctonus jeffreyi Hopk.
Dendroctonus ponderosæ Hopk.

Pinus contorta
Ips radiatæ Hopk.

Pinus radiata
Ips radiatæ Hopk.

Spruce
Crypturgus atomus Lec.
Dendroctonus terebrans Oliv.
Dendroctonus valens Lec.
Dryocœtes americanus Hopk.
Dryocœtes autographus Ratz.
Dryocœtes pseudotsugæ Swaine.
Gnathotrichus materiarius Fitch.
Ips pini Say.
Orthotomicus cœlatus Eich.
Pityokteines sparsus Lec.
Polygraphus rufipennis Kirby.
Monarthrum mali Fitch.
Trypodendron bivittatum Kirby.
Xyleborus xylographus Say.

Spruce, Alaska
Dendroctonus borealis Hopk.

Spruce, big-cone
Dendroctonus pseudotsugæ Hopk.

Spruce, black
Dendroctonus piceaperda Hopk.

Spruce, Engelmann
Dendroctonus engelmanni Hopk.
Dendroctonus ponderosæ Hopk.
Ips interpunctus Eich.
Spruce, red
Dendroctonus piceaperda Hopk.
Dendroctonus punctatus Lec.
Spruce, Sitka
Dendroctonus obesus Mann.
Spruce, white
Dendroctonus piceaperda Hopk.
Dendroctonus ponderosæ Hopk.
Dendroctonus valens Lec.
Scolytus piceæ Swaine.
Ips interpunctus Eich.
Tamarack
Scolytus piceæ Swaine.

Western Pine Beetle

Dendroctonus brevicomis Lec.

This species attacks healthy, injured and felled western yellow pine and sugar pine and is destructive to living timber in the mountains of California and northward and eastward to Washington and Montana. It winters in the bark in all stages and the over-wintering parent beetles extend their galleries (Fig. 144) or excavate new ones and deposit eggs during April and May, the younger stages developing later and continuing to issue from the trees until the last of July. There is a partial second brood; its principal attack occurs the last of August to the middle of September. The infestation is indicated by the reddish borings and the pitch tubes on the trunk or yellowing foliage in August, September or October, depending on the time of attack. The species can be attracted to girdled and felled trees

Fig. 144.—Western pine beetle, work, reduced.

and continued timber cutting usually provides sufficient breeding places. Burning of slash for the control of this species should be done about the first of August for winter and spring cutting and during winter for late summer and fall cutting.

REFERENCES

1906, Hopkins, A. D., U. S. Dept. Agr., Bur. Ent. Bull. 58, Part II, pp. 17–30.
1909, Hopkins, A. D., U. S. Dept. Agr., Bur. Ent. Bull. 83, Part I, pp. 42–49.

SOUTHWESTERN PINE BEETLE

Dendroctonus barberi Hopk.

This borer attacks living, injured and felled western yellow pine in southern Colorado and Utah and in the mountains of Arizona, New Mexico, western Texas and northern Mexico. Its presence in standing timber is indicated by pitch tubes and by the fading yellowish to red foliage (Fig. 145). The winter is passed in all stages, from young to fully developed beetles, the latter issuing the last of May and continuing to appear until the last of June or later. The earlier emerging adults of the first generation attack the trees and begin to deposit eggs about the first of August, the principal attack being in August and September. The control measures are practically the same as in the case of the western pine beetle.

FIG. 145.—Southwestern pine beetle, work, *a* pitch tubes, *b* entrance burrow, *c* egg gallery, *d* ventilating burrow, *e* pupal cells, *f* exit burrow, greatly reduced.

REFERENCE

1909, Hopkins, A. D., U. S. Dept. Agr., Bur. Ent. Bull. 83, Part I, pp. 49–52.

Round-Headed Pine Beetle

Dendroctonus convexifrons Hopk.

This borer attacks injured, felled and healthy western yellow pine from southern Arizona to northern New Mexico and southern Colorado. It winters in the bark in all stages excepting the egg and possibly pupa. The over-wintered parent beetles extend the old galleries or excavate new ones from May until the last of June, while the over-wintered brood of young adults begins to emerge and deposit eggs in June and continues activities until September. There is only a partial generation annually and some individuals may not complete their development until the second year. The removal and burning of the bark for the control of this species should be done between the first of October and the middle of the following June.

Reference

1909, Hopkins, A. D., U. S. Dept. Agr., Bur. Ent. Bull. 83, Part I, pp. 53–56.

Southern Pine Beetle

Dendroctonus frontalis Zimm.

This species attacks healthy, injured and felled trees of all the pines and spruces from southern Pennsylvania southward into Florida and westward into eastern Texas and Arkansas. It winters principally as matured larvæ in the outer bark, though some pupæ and small larvæ also hibernate. The wintering matured larvæ begin to transform to pupæ and adults in March and April, the principal transformation occurring in April. Most of the over-wintering broods have issued by the middle of June and all by the last of July. The over-wintering young adults deposit their first eggs early in May and the making of galleries and oviposition continues probably into June. There are five generations and in the southern section, including the Atlantic or Gulf region of loblolly and long-leaf pines, there is a complex overlapping of probably five or six generations. There is one principal period of destructive attack in the mountains of North Carolina, namely, August and September, while in the area represented by Tryon, North Carolina, there are two, from the middle of June to the last of August, the other occurring in September and October. This latter is probably true of the Atlantic or Gulf region just mentioned. This species shows a decided preference for living healthy trees, although it will breed in those which have been injured or felled. Hopkins considers this one of the most dangerous enemies of the pine forests of the southern states Pitch tubes on the upper to middle trunk are the first external evidences of attack or there may be reddish borings in the loose bark and around the base of the tree. A severe attack will be followed in about two weeks by the fading yellowish appearance of the leaves, and two weeks later the leaves will be yellowish to reddish. All of the bark excepting that on the base of the trunks will be dead and the broods ready to emerge or even out of the trees.

Removing and burning the bark of infested trees is necessary to insure destruction of the insects, since the beetles of this species winter in the outer dry bark. Infested logs should be immersed if the bark can not be removed and destroyed, although if the upper surface of the trunk of felled trees or logs is scored so as to facilitate the entrance of water, the insects will be killed during the winter by the excessive moisture.

References

1899, Hopkins, A. D., W. Va. Agr. Exp. Sta. Bull. 56, pp. 197–461.
1909, Hopkins, A. D., U. S. Dept., Bur. Ent. Bull. 83, Part I, pp. 56–72.

Arizona Pine Beetle

Dendroctonus arizonicus Hopk.

This brown to black beetle attacks healthy, injured and felled western yellow pine in central Arizona. Its habits are apparently similiar to those of the southwestern pine bark-beetle and the control measures would, therefore, be the same as recommended for that species.

Reference

1909, Hopkins, A. D., U. S. Dept. Agr., Bur. Ent. Bull. 83, Part I, pp. 72–73.

Smaller Mexican Pine Beetle

Dendroctonus mexicanus Hopk.

This species attacks pine trees in Mexico and apparently has habits similar to those of the southwestern, southern and Arizona beetles.

Reference

1909, Hopkins, A. D., U. S. Dept. Agr., Bur. Ent. Bull. 83, Part I, pp. 74–75.

Larger Mexican Pine Beetle

Dendroctonus parallelocollis Chap.

This large species, $\frac{1}{5}$ to $\frac{1}{6}$ inch long, attacks living pine trees in Mexico, making coarse, slightly winding, longitudinal or oblique and sometimes branched egg galleries in the inner bark.

Reference

1909, Hopkins, A. D., U. S. Dept. Agr., Bur. Ent. Bull. 83, Part I, p. 75.

Colorado Pine Beetle

Dendroctonus approximatus Dietz

This species attacks injured, dying and healthy western yellow pine from central Colorado and Utah to southern Arizona and New Mexico. The winter is passed in all stages, except the egg and possibly pupa, the over-wintering parent beetles extending their old galleries, excavating new ones and depositing eggs from the beginning of warm weather until into June. The over-wintered broods of young adults begin to issue from the trees early in June and continue until September or later. The principal attack occurs during June, July and August. It appears to prefer injured, dying and felled trees and is, therefore, less likely to become of economic importance.

Reference

1909, Hopkins, A. D., U. S. Dept. Agr., Bur. Ent. Bull. 83, Part I, pp. 77–80.

Mountain Pine Beetle

Dendroctonus monticolæ Hopk.

This borer attacks injured, felled and healthy silver or western white pine, western yellow pine and lodge-pole pine in Montana, western Wyoming, Idaho, Oregon and Washington. It also attacks sugar pine, western yellow pine and lodge-pole pine in the mountains of Washington, Oregon and California. The winter is passed in all stages, except eggs and pupæ, the parent over-wintering adults extending their incompleted egg galleries or excavating new ones and depositing eggs in April and May. The over-wintered broods of young adults begin to emerge in July, the principal period of issuance being in August, although retarded broods continue to come out until September or later. The broods of larvæ begin to transform in April and May and continue until September or later. This species prefers to attack injured and felled trees, though it often infests healthy ones. Pitch tubes, reddish borings and the fading of foliage in fall and spring, followed by a yellowish or sorrel-top condition in May to June and by red tops from July to September, are evidences of infestation. The bark from infested trees should be removed and burned between October and the following June. This insect develops most successfully only in the thinner bark of the lower portion of the trunk of medium to large lodge-pole pines, consequently the removal and burning of this from a comparatively few may be all that is necessary to check an infestation.

References

1909, Hopkins, A. D., U. S. Dept. Agr., Bur. Ent. Bull. 83, Part I, pp. 80–90.

1914, Swaine, J. M., Can. Dept. Agr. Ent. Bull. 7, pp. 26–28.

Black Hills Beetle

Dendroctonus ponderosæ Hopk.

This insect attacks living and sometimes injured and felled yellow pine, lodge-pole pine, limber pine, Mexican white pine, white spruce and Engelmann spruce from the Black Hills, South Dakota, to southern Arizona and westward into Utah. It is classed as a very destructive species. Pitch tubes on the trunks of infested trees in the summer and fall and fading yellowish and reddish foliage the following season from May to August are signs of infestation. The larger and best trees are usually attacked first, but after these are killed the beetle will enter and kill medium to small trees. Over-wintered parent adults begin work in April and May and over-wintered broods of young adults commence to attack trees and deposit eggs toward the last of July. The principal attack is during August and continues into September and October. The removal and burning of bark infested by this insect is advised when possible and efforts directed toward destroying 75 per cent of the insects.

Reference

1905, Hopkins, A. D., U. S. Dept. Agr., Bur. Ent. Bull. 56, pp. 5–24; Bull. 83, Part I, 1909, pp. 90–101.

Jeffrey Pine Beetle

Dendroctonus jeffreyi Hopk.

This borer attacks living and dying Jeffrey and yellow pine in the Yosemite National Park and San Bernardino County, California, the infested trees being indicated by pitch tubes in the summer and fall and during the following May to August by the fading yellowish foliage. The habits of this beetle appear to be quite similar to those of the mountain pine and Black Hills beetles and it is evident that practically the same control measures should be adopted.

Reference

1909, Hopkins, A. D., U. S. Dept. Agr., Bur. Ent. Bull. 83, Part I, pp. 101–103.

Eastern Larch Beetle

Dendroctonus simplex Lec.

This species attacks injured, dying, felled and healthy eastern larch from New Brunswick, Canada, westward to northern Michigan and probably to the western and northern limits of this tree and south in the higher Alleghenies to northeastern West Virginia and western Maryland. Attack is indicated by a flow of resin or red borings on the bark. The broods enter the bark of stumps and logs and the trunks of standing trees from the ground to the branches or into the tops. There is but one generation annually, activities beginning in April, May or June. Infested trees should either be barked, burned or placed in water and the stumps barked between September and the following May. Trap trees felled during May and June appear to be of service in attracting the beetles.

References

1909, Hopkins, A. D., U. S. Dept. Agr., Bur. Ent. Bull. 83, Part I, pp. 103–106.

1918, Blackman, M. W., and Stage, H. H., N. Y. State Col. For., Tech. Pub. 10, pp. 39–41.

Douglas Fir Beetle

Dendroctonus pseudotsugæ Hopk.

This beetle attacks dying, felled and living Douglas fir, big-cone spruce and western larch from British Columbia southward into New Mexico, Arizona and California. Attack is indicated by red borings (Fig. 146) and the pinkish yellow foliage of dying trees, although some remain green in the fall and turn brown during the winter and spring. The insect prefers to infest stumps and logs of felled and standing trees, which are injured or dying, though it attacks and kills healthy trees under favorable conditions. Activities begin in April and the principal attack occurs during April, May and June, though it may continue into July or later. The borer appears to thrive best in the drier regions where the growth of the trees is slow and where there is frequent injury by fire, storms, land-slides and the like. Newly infested trees may be barked during July and the first of August. It is necessary to burn the infested bark. Continued timber cutting usually provides sufficient material so this borer does not become very destructive.

Fig. 146.—Douglas fir beetle, work, greatly reduced.

References

1909, Hopkins, A. D., U. S. Dept. Agr., Bur. Ent. Bull. 83, Part I, pp. 106–114.
1914, Swaine, J. M., Can. Dept. Agr. Ent. Bull. 7, pp. 28–33.

Eastern Spruce Beetle

Dendroctonus piceaperda Hopk.

This species attacks the red, black and white spruces from New Brunswick, Canada, southward in the mountains of New

York and Pennsylvania and westward to Virginia. The insect is rarely found in trees under 10 inches in diameter, breast high, and prefers those with a diameter of 18 inches or more. Infestation is indicated by reddish borings and the numerous fresh gummed spots or pitch tubes mixed with whitish or reddish borings on the bark of the middle or lower portion of the trunk. The fallen needles on the ground have a faded pale green appearance during September and October and the tops are reddish. The winter and spring following there are frequently evidences of woodpecker work. The over-wintered beetles begin to emerge about the middle of June and continue until August, the principal issuance taking place during July. The main deposition of eggs occurs during June and July, although it may continue into September or later. The removal of bark from infested trees results in the death of the immature stages of this insect. If a large amount of timber is infested, logging operations should be directed in such a way as to remove the most of it between the middle of October and the middle of May.

References

1901, Hopkins, A. D., U. S. Dept. Agr., Div. Ent. Bull. 28, n. s., pp. 1–48.
1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 379–385.
1909, Hopkins, A. D., U. S. Dept. Agr., Bur. Ent. Bull. 83, Part I, pp. 114–126.

Engelmann Spruce Beetle

Dendroctonus engelmanni Hopk.

This insect attacks Engelmann and probably other spruces from central Idaho southward to the mountains of southern New Mexico and white spruce in the Black Hills of South Dakota. The medium to larger trees are the ones usually attacked. The beetles begin to emerge from the bark in May or June, the larvæ feeding in the inner bark. This species is regarded by Hopkins as the most important enemy of Rocky

Mountain spruces and in his opinion there "has been a most intimate inter-relation of destructive bark-beetles and forest fires in the denudation of the vast areas of once heavily forested lands in the Rocky Mountain region and that in very many cases the insects have first killed the timber and the fire has then followed, leaving the charred trunks and logs as apparent proof that the fire alone was responsible." Control measures are essentially the same as for the eastern spruce beetle.

Reference

1909, Hopkins, A. D., U. S. Dept. Agr., Bur. Ent. Bull. 83, Part I, pp. 126–132.

Alaska Spruce Beetle

Dendroctonus borealis Hopk.

This species resembles closely in general character the eastern spruce beetle, although it is smaller and presents certain structural differences.

Reference

1909, Hopkins, A. D., U. S. Dept. Agr., Bur. Ent. Bull. 83, Part I, p. 132.

Sitka Spruce Beetle

Dendroctonus obesus Mann.

This borer attacks living bark on the trunks of living, dying and newly felled trees, stumps and large branches of Sitka spruce from Newport, Oregon, northward to the coast of Alaska, probably following the distribution of the tree in which it lives. Apparently it will not attack healthy trees when there is an abundance of felled and injured ones. Activities begin in April and adults begin to infest the trees and deposit eggs early in May and continue through June and probably into August, though the principal attack occurs in May and June.

REFERENCES

1909, Hopkins, A. D., U. S. Dept. Agr., Bur. Ent. Bull. 83, Part I, pp. 132–136.
1914, Swaine, J. M., Can. Dept. Agr. Ent. Bull. 7, pp. 33–36.

RED-WINGED PINE BEETLE

Dendroctonus rufipennis Kirby

This species attacks felled white pine in northwestern Michigan. The primary or egg gallery is evidently of the same character as that of the spruce beetle, although the larval mines are probably like those of the European spruce beetle and the black and red turpentine beetles of this country. The winter is passed as adults and larvæ.

REFERENCE

1909, Hopkins, A. D., U. S. Dept. Agr., Ent. Bur. Bull. 83, Part I, pp. 136–138.

LODGE-POLE PINE BEETLE

Dendroctonus murrayanæ Hopk.

This borer attacks lodge-pole pine in southern Wyoming and occurs northward to Alberta, British Columbia. The egg gallery is like that of the eastern spruce beetle, although the larval mines more closely resemble those of the European spruce beetle. This species attacks living trees near the base, excavating galleries as much as 18 inches in length, with large pitch tubes at the entrance, and deposits the eggs along one side, in cavities partitioned off with borings.

REFERENCE

1909, Hopkins, A. D., U. S. Dept. Agr., Bur. Ent. Bull. 83, Part I, pp. 138–139.

ALLEGHENY SPRUCE BEETLE

Dendroctonus punctatus Lec.

Hopkins took one specimen from a freshly excavated gallery in the bark of a stump of red spruce felled the previous winter. This appears to be a rare species and little is known concerning it.

Reference

1909, Hopkins, A. D., U. S. Dept. Agr., Bur. Ent. Bull. 83, Part I, pp. 139–141.

Black Turpentine Beetle

Dendroctonus terebrans Oliv.

This insect (Fig. 147) attacks the living bark, usually at the base of injured, dying or healthy trees or the stumps of felled pine and spruce from Long Island, New York, southward to Florida and westward to Texas and West Virginia, although

Fig. 147.—Black turpentine beetle, enlarged.

Fig. 148.—Red turpentine beetle, enlarged.

it is more common in the south Atlantic and Gulf states. The stout yellowish-white cylindrical larvæ with reddish heads and stout spines on the dorsal plates of the last abdominal segments do not make separate larval mines but all feed together and eat out cavities in the inner bark from a few inches to several feet square. The broad larval chambers are often filled with semi-liquid resin which does not appear to affect the grubs. Activities begin in March or April, the principal excavation for egg galleries occurring in April and May. The over-wintering large larvæ complete their development in May and June. This species is considered of secondary importance and only occasionally does it cause the death of trees. This is particularly true on Long Island and in New Jersey. Its work, however, makes conditions favorable for injury by fire and invasion by other borers.

Reference

1909, Hopkins, A. D., U. S. Dept. Agr., Bur. Ent. Bull. 83, Part I, pp. 146–153.

Red Turpentine Beetle [1]

Dendroctonus valens Lec.

This species (Figs. 148, 149) attacks the living bark of injured, dying, healthy and felled pine and spruce in the eastern United States and Canada, north from the mountains of North Carolina, westward to the Pacific Coast and southward from British Columbia into Mexico. It is more widely distributed and abundant than the preceding, especially in the northeastern and western areas of the United States. The beetles excavate broad, somewhat irregular, winding, longitudinal egg galleries, the eggs being placed in groups at intervals along the sides of the galleries.

Fig. 149.—Red turpentine beetle, work and grubs, greatly reduced.

[1] The above summary accounts of various species of Dendroctonus would be incomplete without a reference to the admirable, systematic discussion given by Dr. Hopkins in Technical Series No. 7 of the Bureau of Entomology, United States Department of Agriculture, 1909, and although this contains much technical data of interest only to the specialist, it has a fundamental value in accurately defining species and establishing their range. Our Canadian authority on forest insects, Dr. J. M. Swaine, has given an excellent, systematic and economic discussion of Dendroctonus and allied bark-beetles in Technical Bulletin No. 14 of the Entomological Branch of the Canadian Department of Agriculture. Both of these works are profusely and admirably illustrated, the one by Dr. Hopkins delineating the structures of various species and that of Dr. Swaine having many illustrations of work, which are most helpful in identifying bark-borers.

It has been found in practically all of the eastern pines and spruces within its range and in nearly all of the principal western pines but in none of the western spruces, except the white spruce in the Black Hills of South Dakota. It is often exceedingly abundant in the stumps of felled trees, in fire-scorched trees and especially in the bark at the base of those killed by other species of Dendroctonus. This beetle, like the preceding, is of secondary importance.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 342–345 as *D. terebrans.*

1909, Hopkins, A. D., U. S. Dept. Agr., Bur. Ent. Bull. 83, Part I, pp. 153–165.

Coarse Writing Bark-Beetle

Ips calligraphus Germ.

There are a number of species of bark-beetles belonging to the genus Ips which approach in habit and form the much more destructive Dendroctonus, although most of the species of Ips are easily recognized by the usually distinct tooth-like processes on the outer margins of the posterior concave or excavated slope or declivity of the wing-covers. This group, partly on account of the systematic difficulties and presumably also because of its smaller economic importance, has not been studied in the same thorough-going manner and only a few of the more common species are discussed in this connection.

Fig. 150.—Coarse writing bark-beetle, greatly enlarged.

The coarse writing bark-beetle (Fig. 150) is one of the larger and commoner species on or in the thick bark of white pine in the eastern United States and

Canada. It usually occurs in dying trees and logs, although it sometimes enters trees green enough so that pitch tubes are constructed. The beetles are about 1/4 inch long and make more or less longitudinal burrows in the thicker bark of the trunk and larger limbs of various pines. The development of this insect requires about ten weeks. Large numbers were observed entering a slender pine August 5th and eight weeks later two-thirds of the needles were brown and the remainder were changing rapidly. About three weeks later, October 6th, practically all of the needles were brown and dead, the bark mostly dead and all of the bark-borers had forsaken the tree, although some were found in the vicinity. This attack may have been an indirect outcome of a reduced vitality following unusual drought conditions.

Fig. 151.—Pine bark-beetle, work, reduced.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 345–351.
1918, Swaine, J. M., Can. Dept. Agr., Ent. Br., Tech. Bull. 14, pp. 112–113.

Pine Bark-Beetle

Ips pini Say

This is one of the smaller commonest pine bark-beetles

(Fig. 151) occurring in the moderately thin bark of dying trees and apparently killing white pines under certain conditions. It appears to be limited largely to white pine, although it has been recorded from spruce and larch. The beetle is about $\frac{1}{6}$ inch long. Attacks are frequent in midsummer and are indicated by brown borings, pitch tubes and, as the work advances, by fading and browning of the foliage. It is widely distributed in the northern United States and Canada, probably extending into Alaska. Hibernation occurs in the tree and there is probably more than one generation annually, a midsummer attack being known to occur.

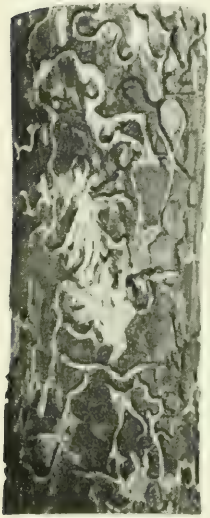

Fig. 152.—Southern ips, work.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 351–356.
1916, Clemens, W. A., Cornell Agr. Exp. Sta. Bull. 383, pp. 287–298.
1918, Swaine, J. C., Can. Dept. Agr., Ent. Br., Tech. Bull. 14, pp. 115–116.

Southern Ips

Ips calligraphus Lec.

The small brown or blackish beetles about $\frac{1}{8}$ inch long occur rather commonly in hard pine at Karner, Albany County, on Long Island and farther south. The insect prefers the thinner bark of smaller trees and the beetles were observed entering limbs in large numbers in October, making very irregular tortuous galleries (Fig. 152) in which hibernation occurs.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 356–359.

Other Bark-Beetles

A number of other species habitually occur in pine, some of the more important being: *I. radiatæ* Hopk. from California to Idaho in *Pinus radiata* and *P. contorta; I. emarginatus* Lec. attacks western yellow pine throughout the yellow pine region of southern British Columbia and extending into the western United States; *I. integer* Eich. recorded from both the western yellow and western white pine throughout the range of yellow pine in the interior of British Columbia and extending south through the western United States into Mexico and occurring as a secondary enemy in slash and dying trees and sometimes as a primary enemy; *I. interpunctus* Eich. in Engelmann and white spruce in Alaska and Yukon, British Columbia, northern and western Alberta and extending into the United States, usually a secondary to sometimes a primary enemy; and *I. oregoni* Eich. in western yellow pine in British Columbia and western United States, probably throughout the range of its host, usually a secondary enemy, although evidently at times an important primary enemy. Very brief accounts of these and other species of Ips are given by Swaine in his "Canadian Bark-Beetles" (Can. Dept. Agr., Ent. Br., Tech. Bull. 14, pp. 107–120).

Orthotomicus cælatus Eich.

This bark-beetle is brownish or nearly black, about $\frac{1}{16}$ inch long and frequently associated in New York state with *Ips calligraphus* Germ. Like other small forms it prefers the thinner bark of smaller trees or the upper part of the trunk of larger trees. Hopkins records this species as very common in West Virginia in partly living bark on living, dying and dead, standing and felled trees and adds that it infests all of the pines, the native and introduced spruces, and that it is widely distributed. It occurs in eastern Canada and the eastern United States and has also been recorded from eastern larch.

REFERENCES

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 354–356.
1918, Swaine, J. M., Can. Dept. Agr., Ent. Br., Tech. Bull. 14, pp. 121–122.

BALSAM BARK-BEETLE

Pityokteines sparsus Lec.

This minute bark-beetle, only about $\frac{1}{10}$ inch long, is a widely distributed and important primary enemy of the east-

FIG. 153.—Balsam bark-beetle, early work.

FIG. 154.—Balsam bark-beetle, advanced work.

ern balsam, frequently attacking trees in hosts. The minute beetles enter the bark and cause more or less exudation of balsam and the common, somewhat characteristic red tops. This borer appears to prefer living, vigorous trees and apparently is able to kill them within a few weeks, since a serious attack is quickly followed by the almost total destruction of the inner bark and outer sapwood, due to the numerous interlacing galleries of both adults and grubs (Figs. 153, 154). The parent galleries are transverse and in the case of a small limb a group of two or three beetles may practically girdle it. This species has been found in small numbers associated with *Ips pini* Say, a species of Pityogenes in white pine and in company with *Polygraphus rufipennis* Kirby in spruce. Systematic cutting of infested trees is the most promising general control measure, although the low commercial value of balsam makes extensive operations inadvisable.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 375–379.
1918, Swaine, J. M., Can. Dept. Agr., Ent. Br., Tech. Bull. 14, pp. 123–124.

Fig. 155.—Spruce bark-beetle, work.

Spruce Bark-Beetle

Polygraphus rufipennis Kirby

This small light brown or black rather stout beetle about $\frac{1}{10}$ inch long is a very common species, occurring particularly in spruce and larch and rarely in pine. It is usually found in dying trees and the bark of logs and slash, although it is a more or less important enemy of black and white spruce. Hopkins considers that this species may have been responsible for the great destruction of spruce timber in West Virginia from 1883 to 1885. Its work is somewhat characteristic (Fig. 155) and the general methods advised for the control of other bark-beetles are equally applicable here.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 386–390.
1918, Swaine, J. M., Can. Dept. Agr., Ent. Br., Tech. Bull. 14, pp. 55–56.
1918, Blackman, M. W., and Stage, H. H., N. Y. State Col. For., Tech. Pub. 10, pp 42–48.

Red Cedar Bark-Beetle

Phlœosinus dentatus Say

This is a rather common light brown or black beetle, about $\frac{1}{16}$ inch long, most easily recognized by the peculiar and somewhat beautiful galleries in red cedar or arbor-vitæ (Fig. 156). It appears to confine its attack to sickly and dying trees and is not an important forest insect. Incipient attacks on recently set ornamentals may be checked by liberal watering.

Fig. 156.—Red cedar bark-beetle, work.

Another species of this genus, *P. sequoiæ* Hopk., about $\frac{1}{6}$ inch long, infests the giant arbor-vitæ or sequoia of British Columbia and the western United States.

Phlœosinus cupressi Hopk. and *P. cristatus* Lec. attack a number of cypresses and cypress-like trees on the Pacific Coast. They excavate galleries several inches long under the bark parallel with the grain of the wood and deposit eggs in small niches on each side. They may also attack small branches about $\frac{1}{8}$ inch in diameter, entering through the bark and tunneling the centers; consequently many twigs break of their own weight. This work is sometimes so general that a pile of fallen twigs $2\frac{1}{2}$ feet high and nearly as wide may be raked up under an ordinary sized Monterey cypress. Adults occur presumably throughout the year.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 391–393.
1915, Essig, E. O., Inj. Ben. Ins. Cal., pp. 312–314.
1918, Swaine, J. M., Can. Dept. Agr., Ent. Br., Tech. Bull. 14, p. 70.
1920, Herbert, F. B., Econ. Ent. Journ. 13: 361–363.

Toothed Spruce Bark-Beetle

Scolytus piceæ Swaine

The rather stout blackish beetle, about ⅛ inch long, breeds in white spruce, balsam, fir and tamarack, the adults issuing from the trees in June and egg-laying occurring in July. It occurs throughout eastern Canada and probably the northeastern United States and breeds ordinarily in half-dried limbs and presumably dying or weakened trees.

References

1918, Blackman, M. W., and Stage, H. H., N. Y. State Col. For., Tech. Pub. 10, pp. 49–55.
1918, Swaine, J. M., Can. Dept. Agr., Ent. Br., Tech. Bull. 14, p. 53.

Dryocœtes Species

Dryocœtes americanus Hopk., probably *D. autographus* Ratz., is a small bark-beetle about ⅛ inch long, occurring commonly in the stumps and lower part of the trunk of spruce, larch and white pine and exhibiting a marked preference for dying or dead bark. It usually works near the surface of the ground and is of little economic importance.

Another common species in this genus, *D. betulæ* Hopk., is somewhat general in the stumps of birch, probably all Canadian and northeastern United States species. *D. pseudotsugæ* Swaine breeds in Douglas fir and may be found in balsam and spruce. It is very abundant in the coast region of British Columbia and probably occurs throughout the range of its host tree southward to Oregon.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, p. 672.
1918, Blackman, M. W., and Stage, H. H., N. Y. State Col. For., Tech. Pub. 10, pp. 59–60.
1918, Swaine, J. M., Can. Dept. Agr., Ent. Br., Tech. Bull. 14, p. 131.

Minute Spruce Bark-Beetle

Crypturgus atomus Lec.

This is one of the smallest and most common bark-beetles, being only about $\frac{1}{16}$ inch long and attacking the pines, spruces, balsam and larch of eastern Canada and the United States. It excavates numerous very small irregular channels in the inner bark. The beetles are sometimes extremely numerous, many mines occurring within a very limited area.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 359–360.
1918, Blackman, M. W., and Stage, H. H., N. Y. State Col. For., Tech. Pub. 10, pp. 55–58.
1918, Swaine, J. M., Can. Dept. Agr., Ent. Br., Tech. Bull. 14, p. 54.

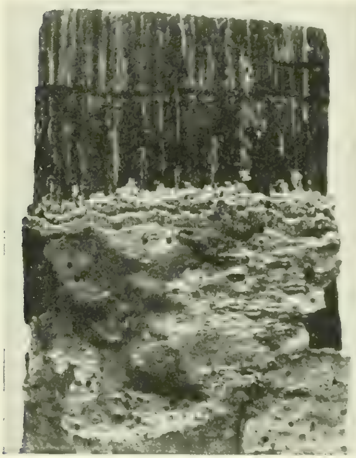

Fig. 157.—Oak bark-beetle, work; note exit holes.

Pityophthorus Species

A number of minute bark-beetles belonging to this genus work in the thinner dying or dead bark of various trees and produce somewhat characteristic galleries. They are not particularly injurious and, as the adults resemble each other closely, they have not been studied thoroughly. The minute oak bark-beetle, *Pseudopityophthorus minutissimus* Zimm. (Fig. 157), is somewhat common in the thinner bark of various oaks and dogwood. A number of species have been recorded from different conifers.

REFERENCES

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, p. 295; 1906, vol. 2, pp. 372–374.
1918, Swaine, J. M., Can. Dept. Agr., Ent. Br., Tech. Bull. 14, pp. 98–104.

ASH TIMBER BEETLE

Leperisinus aculeatus Say

This beetle is the most common ash borer, two females usually working in opposite directions from the entrance point, the latter generally indicated by a slight notch and speedily girdling the infested limb. The eggs are deposited in notches on either side of the primary galleries, the young grubs making slender longitudinal galleries from ½ to nearly 2 inches long (Fig. 158). The species is widely distributed and usually occurs in dying and recently killed trunks and limbs.

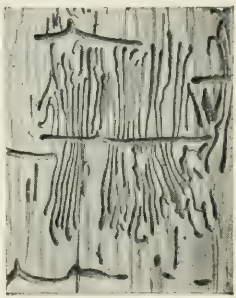

FIG. 158.—Ash timber beetle, work.

REFERENCES

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 288–289.
1918, Swaine, J. M., Can. Dept. Agr., Ent. Br., Tech. Bull. 14, p. 72.

DARK ELM BARK-BORER

Hylurgopinus rufipes Eich.

This species is better known as *Hylesinus opaculus* Lec. It mines under the green bark of sickly and dying elms and also attacks basswood. The parent beetle is dark brown, about $\frac{1}{10}$ inch long, the wing-covers marked with deeply impressed punctured furrows and bearing short hairs. It is not, as a rule, injurious.

References

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, p. 288.
1918, Swaine, J. M., Can. Dept. Agr., Ent. Br., Tech. Bull. 14, p. 74.

Hickory Twig-Borer

Chramesus hicoriæ Lec.

One of the smallest bark-beetles, a stout, black species only $\frac{1}{16}$ inch long, is common in hickory twigs from $\frac{3}{5}$ to 1 inch in diameter, the burrows being mostly in the wood and just scoring the bark. There is a single longitudinal channel about 1 inch long, the larvæ working at right angles for a short distance and then turning and boring nearly parallel with the wood fibers. Adults appear in June and July. The species is widely distributed in eastern North America.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 448–449.
1918, Swaine, J. M., Can. Dept. Agr., Ent. Br., Tech. Bull. 14, p. 58.

Ambrosia or Timber Beetles

The ambrosia or timber beetles belong with the bark-beetles and are most interesting on account of their feeding on ambrosia or fungus grown in the cylindrical usually blackened galleries, each species living on a peculiar fungus. They are of great economic importance because they cause pin holes, principally in the sapwood, and thus materially reduce the commercial value of the lumber. These insects attack trees which have been weakened or are in a dying condition, the moisture being necessary to the successful development of the young. The holes made in the wood by these insects afford entrance to wood-staining fungi. These latter cause rapid discoloration and also reduce the value of the product. The borers are rather easily recognized by their somewhat elongate cylindric form and especially by the uniform sized galleries, the latter penetrating to a considerable depth, following a rather well-defined plan and having the walls blued or blackened by fungus, which latter is carefully propagated by the mother beetle on a packed bed or layer of chips, sometimes near the entrance in the bark, though usually at the end of a branch gallery. In some species it is grown only in certain brood chambers.

Fig. 159.—Platypus, greatly enlarged.

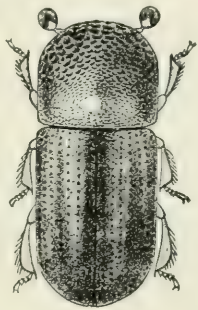

Fig. 160.—Spruce timber beetle, greatly enlarged.

The pin-hole borers (Fig. 159) in cypress, *Platypus compositus* Say, *Xyleborus sacchari* Hopk. and others, are sometimes so abundant in the Gulf states that trees girdled by the lumberman and left standing several months, or until the timber is dry enough to be floated, are invaded by hosts of these little insects and millions of feet of timber have their value reduced from 10 to 25 per cent or more. The remarkably light balsa wood of Central America is also attacked by ambrosia beetles.

Spruce timber beetle, *Trypodendron bivittatum* Kirby (Fig.

160), is a rather stout brownish-black beetle, ⅛ inch long, which attacks the exposed wood of spruce, pine, arbor-vitæ, larch, hemlock and balsam over much of the timbered area of the northern United States and southern Canada. The galleries penetrate the wood vertically for some distance and then branch, the brood chambers being arranged at about equal distances and extending above and below in a direction parallel with the wood fibers. Several other species occur in the conifers and some attack the hardwoods.

Xyloterinus politus Say is about ⅛ inch long, varies from light brown to nearly black and commonly attacks beech,

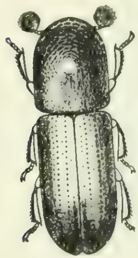

FIG. 161.—Eastern pine wood-stainer, greatly enlarged.

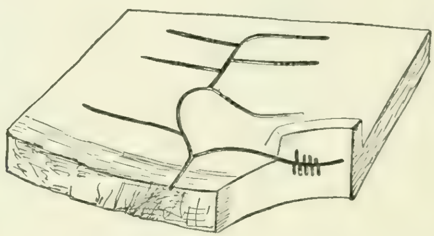

FIG. 162.—Eastern pine wood-stainer, galleries in pine, reduced.

maple, birch and other hardwood trees in a sickly or dying condition. It is widely distributed in the eastern United States and eastern Canada.

Eastern pine wood-stainer, *Gnathotrichus materiarius* Fitch (Figs. 161, 162), is a more slender brownish-black beetle than the preceding. It attacks pines, spruce and larch throughout eastern Canada and the eastern United States and makes slender cylindrical burrows across the wood fibers, the lateral branches usually being parallel with the lines of growth and leading to a series of vertical brood chambers. Other species of this genus attack western conifers and are mentioned briefly by Swaine.

The popular name of the apple wood-stainer, *Monarthrum mali* Fitch (Figs. 163, 164), is a misnomer since this common

Fig. 163.—Apple wood-stainer, enlarged.

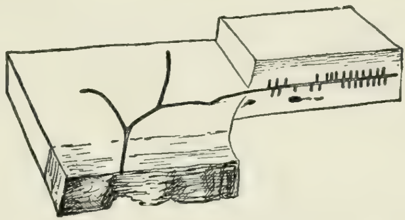

Fig. 164.—Apple wood-stainer, work in maple, reduced.

ambrosia beetle breeds in oak, birch, beech, spruce, pine and a number of other trees. The adult is a minute reddish-brown cylindrical beetle about 3/32 inch long. It sinks its slender blackened galleries deeply into the wood of a considerable variety of trees and, like its allies, subsists upon a peculiar fungus or ambrosia.

The hickory timber-beetle, *Xyleborus celsus* Eich. (Figs. 165, 166), is a cylindrical brownish beetle about 3/16 inch long which sinks its rather characteristic simple galleries deep into the wood. It occurs generally in the eastern and

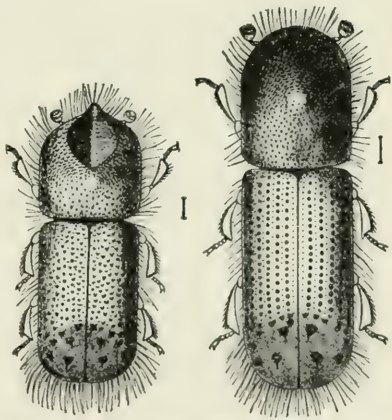

Fig. 165.—Hickory timber-beetle, male and female, greatly enlarged.

southern states. Other species of this genus with similar habits occur in various hardwoods. *X. xylographus* Say has been recorded on the Pacific Coast from beech, larch, pine, hickory, oak, maple, hemlock and spruce by Van Dyke.

Protection from invasion by ambrosia beetles depends in considerable measure on avoiding conditions attractive to these insects and within certain limits these vary with the different species. Trees cut in late fall and winter generally remain in an attractive condition till early the following spring, while those felled between April and September may be attacked within a few days, although the danger period for a given species may not extend over more than a few weeks. There are certain general precautions which may be followed. There should be as little delay as possible between cutting and manufacture into rough products, especially in the case of trees cut from April to September in the region north of the Gulf states and from March to November in the latter, while late fall and winter cuttings should all be worked up by March or April. Timbers should not be left round in the woods or on skidways during the danger period, and if this is unavoidable, every precaution should be taken to hasten the rapid drying of the inner bark by keeping the logs off the ground, in the sun or in loose piles, or else, if feasible, they should be kept in water. Removing the bark is also serviceable in the case of trees which will not be injured by checking or season cracks. The cutting or girdling should be timed so as to avoid the most dangerous periods of the year. Products

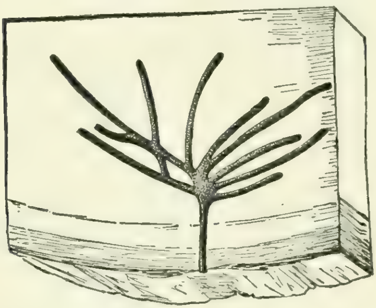

FIG. 166.—Hickory timber-beetle, galleries, reduced.

cut from saplings and left with the bark on can be protected to a considerable extent by removing from the woods soon after they are cut or by not storing for several months in one place.

Two series of ambrosia beetles are concerned in the pin-hole injury to cypress.[1] One, represented by *Xyleborus sacchari* Hopk., is a small, short, cylindrical, reddish beetle $\frac{1}{10}$ to $\frac{1}{8}$ inch long and limited exclusively to sapwood. As a rule it is not common in girdled trees, although abundant in logs from living trees. The other, represented by *Platypus compositus* Say, is an elongate, slender, reddish, cylindrical beetle $\frac{3}{8}$ inch long which often extends its borings deep into the heartwood and frequently is quite injurious both to felled and girdled trees. It has been found that trees girdled in March, April, October and November are but slightly damaged by borers belonging in the latter class, while those girdled in May, June, July and September were more or less seriously injured, and apparently those girdled in August were not so badly affected as those in July and September. These pin-hole borers must have moist wood in which to burrow and rear their young. Living trees felled in April and August appear to be especially attractive to the ambrosia beetles and these might be used as traps to attract the insects and thus lessen the probabilities of their attacking others. It is important that trap trees felled in April be burned or placed in water during the following June and those felled in August should be treated in the same manner in October. Comparatively worthless trees may be utilized as traps and if those selected stand near water, it is easier to dispose of them in one of the ways indicated above.

Pin-hole damage to stave and shingle bolts cut in the warm season can be prevented by removing the bark from the timber as soon as it is felled and by converting the bolts into the

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[1] 1907, Hopkins, A. D., U. S. Dept. Agr., Bur. Ent., Circ. 82, pp. 1–4.

smallest practicable dimensions and piling them so as to hasten drying.

In brief, timber should be cut at the time when insect injury is less likely to develop and the most practicable means employed to hasten seasoning because these beetles in particular are attracted by partially seasoned stock.

References

1905, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 1, pp. 289–293, 369–370.
1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 371–372, 446–448.
1918, Swaine, J. M., Can. Dept. Agr., Ent. Br., Tech. Bull. 14, pp. 85, 87, 91, 128, 383.

CHAPTER XV

CONIFEROUS LEAF-FEEDERS

Relatively few species are included in this group, largely because only the very destructive forms are considered of sufficient economic importance to warrant treatment in this connection. There are many other leaf-feeders which subsist upon the foliage of evergreens, although they are usually present in such small numbers as to be practically negligible in average forest areas.

Leaf-Feeders

Pine

Greenish or yellowish false caterpillars an inch or less in length, feeding in clusters, defoliating branches and sometimes trees.

Pine sawflies, *Diprion* and *Neodiprion*, p. 281.

Greenish purplish-tinged caterpillars about an inch long and with two yellowish-white stripes defoliate various western pines.

Pine butterfly, *Neophasia menapia* Feld., p. 284.

Small yellowish caterpillars about ⅓ inch long web and injure the terminal buds and mine the twigs and bases of the leaves.

Nantucket pine moth, *Evetria frustrana* Scudd., p. 285.

Spruce and balsam

Dark-brown caterpillars ¾ inch long attack spruce, producing a condition suggestive of the work of a light fire and causing the death in masses of a few to many trees.

Spruce bud-worm, *Harmologa fumiferana* Clem., p. 285.

Pine Sawflies

Diprion and *Neodiprion*

Greenish or yellowish false caterpillars an inch or less in length frequently feed in clusters and defoliate branches or entire trees.

The sawflies on pines and related evergreens have so much in common that they are discussed under one head. They are all false caterpillars of moderate size and can be recognized easily by the numerous legs and the curled posterior extremity. The eggs of these insects are deposited in little slits cut in the leaves of the host plant.

The imported pine sawfly, *Diprion simile* Hartig, is a European species first discovered in this country at New Haven, Connecticut, in 1914. It is larger than the native

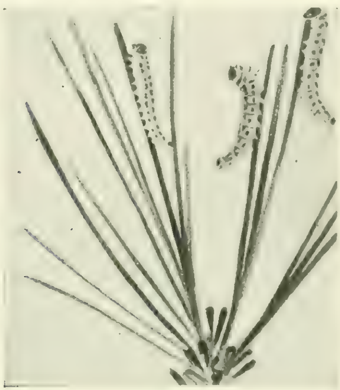

Fig. 167.—Leconte's sawfly on pine.

Fig. 168.—Fir sawfly on pine.

species and has been associated with the European *D. pini* in extensive depredations in northern Europe. The full-grown sawfly is about an inch long, the head is black, the body greenish-yellow with a mid-dorsal double stripe of brown and on either side a yellow stripe broken with transverse brown markings, the remainder of the sides dark brown with many irregular yellowish or whitish spots. The winter is passed in an oval rather thick brown cocoon about ⅜ inch long, the adults appearing the latter part of April, the first brood of larvæ feeding during May and early June, and the second in

August and September. Several parasites are known to prey on the insect in this country.

The larvæ of Leconte's sawfly, *Neodiprion lecontei* Fitch (Fig. 167), are red-headed, dirty yellowish, black-spotted caterpillars about an inch long when full grown. They feed in clusters usually near the tips of the branches, the first period of larval abundance being July and the second in September and October. Transformations occur in an oval brown cocoon spun in any shelter near the surface of the ground.

The yellowish, black-headed, black-spotted, false caterpillars of Abbott's pine sawfly, *Neodiprion pinetum* Norton, are nearly an inch long when full grown. There are probably two periods of larval abundance, the first being in midsummer and those of the second in September and October.

The fir sawfly, *Neodiprion abietis* Harris, has a dark-headed, dark green, dark striped, false caterpillar about ½ inch long which defoliates fir, spruce and pitch pine in midsummer and probably early fall. It is easily distinguished from the other native species by marked differences in colorational characters (Fig. 168).

The European larch sawfly, *Nematus erichsonii* Hartig, has repeatedly defoliated extensive areas of larch in the Adirondacks and Canadian forests. It is well established in the northeastern United States and Canada. The fully grown larva may be recognized by its round jet black head and the peculiar green of the body resembling that of the underside of a larch leaf. There are no lateral stripes or spots (Fig. 51). This insect attacks ornamentals as well as trees growing in the forest late in June, during July and early in August.

Ordinarily outbreaks by pine sawflies are not noticed until too late because the larvæ develop rapidly and are usually full grown or nearly so when discovered. The few occasionally found on a small branch of an ornamental are easily removed or crushed or the tree can be protected by early spraying with a poison.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 413–423.
1918, Britton, W. E., Conn. Agr. Exp. Sta. Bull. 203, pp. 273–290.
1921, Middleton, W. M., Journ. Agr. Res. 20 : 744–760.

Pine Butterfly

Neophasia menapia Felder

Greenish purplish-tinged caterpillars about an inch long and with two yellowish-white lateral stripes may defoliate various western pines.

Adults and larvæ of this species attracted the notice of R. H. Stretch in midsummer, 1882, the insects at that time being exceedingly abundant and injurious in the vicinity of Loon Lake and Brown's, some fifty miles from Spokane Falls, Washington. The pests then displayed a marked preference for yellow pine, *Pinus ponderosa,* although *Pinus contorta* and *Abies balsamea* were also injured. Subsequent observations have shown that the nut pine, *Pinus monticola,* may be affected seriously. It is stated that the butterflies were so numerous about 1883 that the bay at Seattle was almost white with their floating bodies, and in 1898 dead butterflies occurred in such numbers in parts of Idaho as to dam small streams. The insect has been recorded from California and Colorado, northward into British Columbia and eastward into Idaho. The outbreaks are evidently at irregular periods and occasionally very severe.

References

1882, Stretch, R. H., Papilio, 2 : 103–110.
1890, Packard, A. S., U. S. Ent. Comm. 5th Rept., pp. 762–767.
1908, Hopkins, A. D., Yearbook, U. S. Dept. Agr., pp. 159–160.

NANTUCKET PINE MOTH

Evetria frustrana Scudder

The new growth of certain pines may be injured severely by small yellowish caterpillars which spin a delicate web around the terminal bud and mine both the twig and the bases of the leaves.

This species has a record of being very injurious to hard pines, *P. inops* and *P. rigida* on Nantucket Island and that general region, and also in the scrub pine area of Virginia near Washington. A serious infestation may result in practically every new shoot being attacked. The work is so unobtrusive, due to the fact that the small caterpillars feed under the delicate web inclosing the base of the bud and the surrounding new leaflets, that it is hardly noticed until the twigs are almost completely destroyed. The small yellowish caterpillars are only about ⅓ inch long. They begin feeding in early spring and transform to pupæ early in June, a second brood developing in the vicinity of Washington the latter part of August. Hibernation is usually in the pupal stage.

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1890, Packard, A. S., U. S. Ent. Comm. 5th Rept., pp. 745–754.
1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 405–407.

SPRUCE BUD-WORM

Harmologa fumiferana Clem.

Trees appearing as though a light fire had passed through them or dying in masses of greater or less extent may have been injured by this very destructive pest (Figs. 169, 170).

The spruce bud-worm is one of the most serious enemies of balsam and spruce, not only because of the direct injuries which are very great in themselves, but on account of the marked insect damage developing as a consequence of large areas of sickly or dying trees offering unusually favorable con-

FIG. 169.—Spruce bud-worm, adults and eggs, greatly enlarged.

ditions for the breeding of enormous numbers of bark-borers, which in turn may spread to other trees and start a series of

FIG. 170.—Spruce bud-worm, pupæ and larva.

attacks with far-reaching consequences. There has been in recent years a wide-spread outbreak of spruce bud-worm in the northern forest areas, resulting in 50 per cent of the merchantable balsam in the province of Quebec, Canada, being killed and three years' increment loss on the spruce. There was a great outbreak of this insect some twelve years earlier and again in the late 70's and early 80's. An attack may continue for some three or four years and may be followed by slow dying of trees from a variety of causes.

The grayish brown-marked moths with a wing spread of about ¾ inch are most numerous in June and early July, depositing their pale green, scale-like, flat eggs upon the needles. Hatching occurs in about ten days. The young caterpillars winter in a partly grown condition beneath various shelters and feed for three weeks or more in early spring. The larvæ attack the leaves or needles of the terminal shoots both of the first and second year's growth. There is a marked preference for balsam, particularly the taller trees. The relation between dead spruce and dead fir is seldom greater than two to three. The larvæ attack spruce after the balsam is largely consumed. They gnaw off the bases of the needles, separating them from the twig, meanwhile spinning a silken thread by which the needles and bud-scales are loosely attached to the twigs. The caterpillars move about freely and do not live in a regular tube, although they sometimes draw together two adjacent shoots. The full-grown caterpillar is about ¾ inch long with an unusually thick, stout, dark brown body bearing conspicuous yellowish-white warts or tubercles. The life cycle is completed in June or July.

Balsam is the favorite tree for egg-laying and feeding. Recent investigations indicate that predominance of balsam, especially tall mature trees, is favorable to a great multiplication of the pest and a resultant wide-spread injury to the more valuable spruce. Consequently, any method of forestry which tends to establish a more normal relation between the proportion of balsam and spruce than usually obtains will tend to prevent great periodic outbreaks at irregular intervals. Spruce and balsam in a mixture of hardwoods are fairly immune. Restricted outbreaks of this pest can be controlled by cutting the infested trees in the winter and thus starve out the young larvæ. This is obviously impracticable in the case of outbreaks developing over hundreds of square miles of territory.

Craighead recommends the use of various species of conifers, especially those not affected by the bud-worm and mixing them thoroughly over an area and also experimenting with mixed stands of rapidly growing hardwoods, largely for the sake of obtaining conditions which can be studied advantageously when the next serious bud-worm outbreak occurs.

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PART IV

Insects in General

The tree-frequenting insects are interesting to many lovers of wild life. The more common species and groups are briefly noticed in this glimpse, as it were, of woodland insects and their relation to each other.

Systematic Account

This discussion is concerned primarily with the characteristics and habits of the more important groups of insects affecting trees and shrubs. The large number of insect species and the great diversities in form and habit make it impossible to give within reasonable space limitations a fairly complete account of the group as a whole.

For a characterization of insects and a brief outline of the earlier stages, see page 5.

Key to the More Important Groups of Forest and Shade Tree Insects

Series with Complete Metamorphosis

Wasp- or bee-like insects having four membranous wings with comparatively few or no transverse veins, the hind-wings smaller than the fore-wings and the mouth-parts adapted for biting and sucking.
Hymenoptera, bees, wasps, ants and the like, p. 292.

Usually hard-shelled insects with horny wing-covers or elytra which meet in a straight line down the middle of the back and covering a single pair of membranous wings, mouth-parts adapted for biting.
Coleoptera, beetles, p. 298.

The four membranous wings (a few species are wingless) are covered with overlapping scales which are easily rubbed off as powder; the mouth-parts are adapted for sucking.
Lepidoptera, butterflies and moths, p. 325.

Insects with two membranous wings, the veins usually relatively few, mostly moderate sized to small.
Diptera, true flies, p. 353.

Series with an Incomplete Metamorphosis

Insects with sucking mouth-parts and four wings, the anterior pair in one suborder thickened at the base and the thinner extremities overlapping.
Hemiptera, true bugs, aphids and scale insects, p. 355.

Insects with four wings, the first pair thickened and overlapping when at rest, the second thinner and folded in plates like a fan; mouth-parts adapted for biting.

Orthoptera, grasshoppers and allies, p. 361.

Hymenoptera

Bees, Wasps, Ants and the Like

A very large number of insects belong to this relatively well-known group. All have four membranous wings with comparatively few or no transverse veins. The hind-wings are smaller than the fore-wings and the mouth-parts are adapted for biting and sucking. The ovipositor is frequently modified into a stinging or piercing instrument and the transformations or metamorphoses are complete.

The insects comprising the Hymenoptera vary greatly in appearance and structure. There is a long series of mostly leaf-eating false caterpillars, numerous species of gall-wasps, large numbers of parasitic insects, many so extremely minute that they develop successfully within the eggs of even very small insects. These last are beneficial, because most of them live at the expense of insects which otherwise might become destructively abundant.

Fig. 171.—White-horned Urocerus.

Siricidæ, horn-tails.

These are mostly large cylindrical insects which have gained their common name because the end of the body in both adult and larva usually bears a spine or horn. The pigeon tremex, noticed elsewhere, is a common and characteristic representative of the group and, like a number of its associates, lives in decaying usually fungus-infested wood.

White-horned Urocerus, *Urocerus albicornis* Fabr. (Fig.

171), is one of the larger bluish-black horn-tails about 1¼ inches long, recorded from spruce, hemlock and fir, the adults being abroad during July and August. It is closely related to the pigeon tremex and apparently restricts its attack to dying or dead trees. The banded horn-tail, *U. abdominalis* Harris, may prove to be the male of this species. There is also a small, blue, red-legged horn-tail, *Paururus cyaneus* Fabr., which attacks spruce and fir.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 667–669.

Xyphidridæ.

This group comprises moderate-sized somewhat soft-bodied boring wasps, the larvæ of which work in decaying wood and have a horny process at the posterior extremity much as in the Siricidæ. These insects are comparatively rare and are of little or no economic importance.

Xyphidria provancheri Cress. has a whitish larva, easily recognized by the moderately stout horn at the posterior extremity. It bores in the partly decayed wood of standing white birch, the galleries being about ⅛ inch in diameter and the adults issuing from the tree through circular holes of about the same size.

The white-horned maple borer, *Xyphidria albicornis* Harris, is a slender blackish wasp-like insect about ½ inch long and with most of the antenna white. The larva works in decaying hard maple limbs, presumably in much the same way as *X. provancheri* Cress. bores in decaying birch.

Slender birch horn-tail, *Konowia attenuata* Norton, makes moderately large cylindrical burrows in decaying birch.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 459–466.

Tenthredinidæ, sawflies.

The sawflies comprise a rather distinct group and are so named because the females are provided with somewhat typical serrate ovipositors with which incisions are made, usually in leaves, for the reception of eggs. The larvæ of most are leaf-feeders, although some are gall-makers. They may be distinguished readily because of the many legs, having, in addition to the six true or thoracic legs, twelve to sixteen abdominal pro-legs. Several species are extremely abundant and destructive over large areas as, for example, the well-known larch sawfly of the Adirondacks. Most of these forms are comparatively harmless, and yet excite interest when they become somewhat abundant, a marked exception being the larch sawfly, *Nematus erichsonii* Hartig, a European species, noticed briefly with certain pine sawflies.

Amauronematus luteotergum Norton has a black-headed, greenish larva, which feeds gregariously on the edges of alder leaves in the Adirondacks. The full-grown larva is about ¾ inch long.

Hylotoma pectoralis Leach occurs rather commonly during August and early September on birches. It has a yellowish black-spotted larva, about ¾ inch long and with a reddish-yellow head. It is generally distributed and appears to be somewhat abundant in the Adirondacks. The winter is passed in the cocoons, the larvæ appearing the following July or early in August.

The yellowish, black-spotted larvæ of *Hylotoma scapularis* Klug., nearly ¾ inch long when full grown, feed on the foliage of American elms in August. They show a general resemblance to those of *H. pectoralis* Leach.

Hylotoma macleayi Leach has black-headed, yellowish-green, black-spotted, false caterpillars nearly ¾ inch long. They feed in August on choke-cherry foliage, the adults appearing the following May.

Nematus unicolor Marlatt is a brown-headed greenish sawfly larva about ¾ inch long when full grown. It occurs on the underside of white birch leaves.

Pristiphora sycophanta Walsh is a whitish green-tinted false caterpillar about ½ inch long when full grown. Transformations occur in brownish cocoons in the earth. It is found on willow, white and yellow birch.

Pteronus hudsonii Dyar is a black-headed bluish or leaf-green sawfly larva having a series of large orange-yellow blotches on segments three to twelve and numerous black spots. It is somewhat over ½ inch long when full grown and occurs on the edges of poplar leaves.

The uniformly pale green, false caterpillars of the spruce sawfly, *Pteronus integer* Say, nearly ¾ inch long when full grown, feed singly on spruce the latter part of the summer, the adults being abroad in early June.

Pteronus latisfaciatus Cresson has brown-headed, purplish, solitary or partly gregarious larvæ about ¾ inch long when full grown. They occur on white birch.

The false caterpillar of *Pteronus mendicus* Walsh is a nearly uniform leaf-green, about ½ inch long when full grown. It feeds on willow.

The black-headed green larva of *Pteronus odoratus* Dyar is about ½ inch long and feeds on willow.

Pteronus thoracicus Harrington is a greenish solitary sawfly found on the under surface of the leaves of shad-bush, *Amelanchier canadensis*. The full-grown larva is about ½ inch long.

Pteronus vertebratus Say is a greenish, solitary, edge-feeding poplar sawfly larva which is about ½ inch long when full grown.

Large flocculent white masses on the underside of butternut leaves in midsummer may conceal the bluish yellowish-white larvæ of the butternut woolly worm, *Monophadnus caryæ*

Norton. It is about $\frac{3}{4}$ inch long. The insect is somewhat rare. These false caterpillars feed in company, devouring the terminal part of the leaf and leaving the midrib and usually a small basal part.

False pine webworms, *Lyda* sp., *Benta melanogrammos* Zell. and *Itycorsia zappei* Roh. (Fig. 172), inhabit loose web nests thickly sprinkled with excrement and occur rather commonly

FIG. 172.—False pine webworm, work.

on the terminal twigs. They are about $\frac{3}{4}$ inch long when full grown, greenish or yellowish-brown, and most easily recognized by the conspicuous antennæ and the almost equally developed anal filaments.

Pontanias or willow gall-flies resemble each other closely and produce galls on the leaves of willow.

The willow apple-gall, *Pontania pomum* Walsh, is smooth, globular or a slightly oval rosy-cheeked gall, resembling a miniature apple and measuring from 1/3 to 1/2 inch. It occurs upon one side of the midrib of the leaf of *Salix caudata.*

The willow pea gall, *Pontania pisum* Walsh (Fig. 173), is subspherical, pea-like and found on the under surface of the leaves of *Salix discolor.*

FIG. 173.—Willow pea gall.

The galls of *Pontania desmodioides* Walsh are smooth, flattened, yellowish-green and occur on both sides of the leaves of *Salix humilis.*

The galls of *Pontania hyalina* Norton are fleshy, red and are arranged in two parallel rows, one on either side of the midrib, sometimes touching but not originating from the latter and rarely extending to the edge of the leaf. They occur on *Salix fragilis.*

FIG. 174.—Ibalia maculipennis.

Several species of the genus Euura produce petiole or twig swellings upon willows.

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1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 536–677.
1918, Felt, E. P., N. Y. State Mus. Bull. 200, pp. 33–36.
1920, Britton, W. E., Conn. Agr. Exp. Sta. Bull. 226, pp. 179–182.

Ibaliidæ.

The striking and peculiar insect placed here is closely related to the gall-wasps or Cynipidæ, although it is presumably parasitic upon the pigeon tremex and possibly related borers working in dead and dying trees.

Ibalia maculipennis Hald. (Fig. 174) is a small wasp-like insect some 5/8 inch long. It is black with strongly contrasting yellowish markings on the greatly compressed abdomen. It is a parasite of various borers, occurring in dying and dead trees.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, p. 499.

Cynipidæ, gall-wasps.

This is a large group of small insects best known on account of the numerous galls produced by the various species. See page 111.

Coleoptera

Beetles

The beetles are easily recognized by the pair of horny wing-covers known as elytra which meet in a straight line down the middle of the back and serve as covers for a single pair of membranous wings. These insects have biting mouth-parts and the metamorphoses are complete.

A very large number of beetles are known. More than 10,000 representing upwards of eighty families occur in America north of Mexico. The more important forest insects are comprised in the flattened metallic Buprestidæ, the long-horned borers or Cerambycidæ, the abundant leaf-feeders or Chrysomelidæ, the weevils or Curculionidæ and the bark or wood-borers, the Ipidæ.

Cleridæ, checkered beetles.

Many of the species are beautifully marked with strongly contrasting colors. They are harder and firmer than the lightning beetles and not so hard as the click beetles. Frequently they are more or less ant-like in form, the thorax in these cases being slightly narrower than the head and narrower than the wing-covers. They occur mostly on flowers, recently cut timber, trunks and foliage of trees and low shrubs. Both adults and larvæ are predaceous on many wood-borers, especially bark-beetles, and the rather slender reddish or brown grubs are frequently found in the burrows of these latter.

Fig. 175.—Monophylla terminata, enlarged.

Monophylla terminata Say (Fig. 175) is a small cylindrical nearly black beetle about 1/4 inch long and remarkable because of the greatly developed antenna in the male.

The removal of a piece of bark from a tree badly infested by bark-borers is very likely to reveal a number of active, rather stout, reddish and black adults of the American bark-beetle destroyer, *Thanasimus dubius* Fabr. These prey on the bark-borers and are, therefore, beneficial.

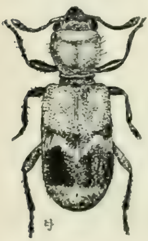

Fig. 176.—Enoclerus quadriguttatus, enlarged.

Enoclerus quadriguttatus Oliv. (Fig. 176) is a jet-black beetle only 1/4 inch long, with the basal portion of the wing-covers reddish and near the middle an irregular transverse band of silvery-white markings. It is a predaceous beneficial species found in borer-infested pine bark in midsummer.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 500–502, 666.

Corynetidæ.

These small beetles, formerly associated with the checkered beetles or Cleridæ, have recently been separated as a distinct family. They are with little question predaceous on various wood-borers.

Phyllobænus dislocatus Say (Fig. 177) is a small blackish yellow-marked beetle about $\frac{3}{16}$ inch in length found in the galleries of certain borers on hickory, namely, those of *Chrysobothris femorata* Fabr. and *Magdalis olyra* Herbst.

Fig. 177.—Phyllobænus dislocatus, enlarged.

Chariessa pilosa Forst (Fig. 178) is a rather stout black beetle, with yellow-margined thorax, about $\frac{1}{2}$ inch long and easily recognized by the branching antenna of the male. It presumably preys on various borers.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 503–504.

Mordellidæ.

The large number of small beetles belonging here are most easily recognized by their somewhat triangular form and the arched body, the head being bent down and the abdomen ending in a slender point. Many of the common species are black, some are variegated and all clothed with fine hairs. The beetles are rather common on flowers. The grubs live in rotten wood and in the pith of various plants. They are not of much economic importance.

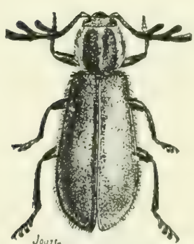

Fig. 178.—Chariessa pilosa, enlarged.

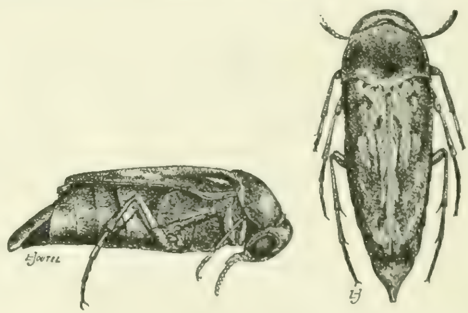

Fig. 179.—Tomoxia bidentata, enlarged.

Tomoxia bidentata Say (Fig. 179) is a narrow triangular grayish beetle from 3/8 to 1/2 inch long which is found somewhat commonly on hickory in June.

Fig. 180.—Tomoxia lineella.

Tomoxia lineella Lec. (Fig. 180) is a narrow, triangular, brownish, gray-marked beetle about 1/4 inch long. It occurs on decaying hickory in early June. It is easily recognized by the somewhat variable linear gray markings on the thorax and wing-covers.

Mordella borealis Lec. is a small narrow triangular beetle about 3/16 inch long irregularly marked with silvery-white. It occurs in midsummer on spruce and decaying maple.

Mordella octopunctata Fabr. (Fig. 181) is a narrow triangular blackish beetle, 1/4 inch long, marked with lines and spots of yellowish or orange. It occurs on various flowers in June. It is one of the prettiest of a considerable series of related forms. The larva bores in oak.

Fig. 181.—Mordella octopunctata.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 433, 441–442, 672.

Anthicidæ.

These are medium or usually small-sized insects varying much in form, although agreeing in having the head drooping and strongly constricted behind the eyes to a slender neck. They are often marked with bright or contrasting colors. Some bear a striking resemblance to ants and others are remarkable for the prominent horn on the front of the thorax. They are found usually on flowers, although some live in rotten wood.

Notoxus bifasciatus Lec. is a small brown or blackish beetle only 1/8 inch long with lighter transverse bands on the wing-covers and a conspicuous pronotal process. It may be exceedingly common on hard pine during June and early July. The related *N. anchora* Hentz. (Fig. 182) is very similar, although lighter colored. Both species probably feed on fungi.

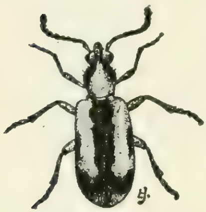

FIG. 182.—Notoxus anchora, enlarged.

REFERENCE

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 696–697.

Elateridæ, click or snapping beetles.

These medium-sized or small dull brown or black insects are easily recognized by their elongate form, tapering more or less toward each end, and especially by the peculiar ability to throw themselves several inches in the air with a marked snap or jump. One of the most noteworthy native species is the eyed Elater, *Alaus oculatus* Linn., described elsewhere.

The larvæ or grubs are long, narrow, of a nearly uniform diameter, hard and brownish or yellowish. They are the familiar wire-worms of the grassland and potato fields. Nearly 600 species are known in the United States.

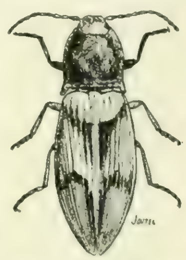

FIG. 183.—Corymbites hieroglyphicus.

Corymbites hieroglyphicus Say (Fig. 183) is a yellowish snapping beetle about ½ inch long, the wing-covers marked with curved dark brown or black lines. It is found on hard pine in midsummer.

Buprestidæ, metallic wood-borers.

The beetles are flattened, frequently brilliantly colored, usually stout and sometimes cylindrical but with a broad thorax and with the wing-covers tapering back from the shoulders. There are a large number of injurious species in this group, the young or borers being easily recognized by the greatly enlarged thoracic segments, giving the grubs a flat-headed appearance, hence the common name of "hammer heads" or "flat heads." The burrows are broad and shallow and in the case of some species are limited very largely to the inner bark and outer sapwood. A few species live as miners in leaves. The adults are usually found on flowers or the branches of limbs or trees basking in the sunshine. A few species of this group are mentioned below, although some of the more important are discussed in connection with the trees they usually injure.

FIG. 184.—Adult of flat-headed borer, Chalcophora virginiensis.

Brachys ærosa Melsh. is a small, triangular, flattened metallic-colored beetle only about $\frac{3}{16}$ inch in length which occurs on oak and elm leaves in midsummer. The larvæ are leaf-miners. A related species, *B. ovata* Weber, is very common on scrub oak foliage in May and June.

Two large dark metallic or copper-colored beetles ranging in length from $\frac{3}{4}$ to $1\frac{1}{4}$ inches occur rather commonly on pine. The larger is *Chalcophora virginiensis* Drury (Fig. 184) and the smaller *C. liberta* Germ. The smaller golden Buprestis, *B. striata* Fabr., is a brilliant, sparkling, copper-red beetle, varying in length from about $\frac{1}{2}$ to nearly $\frac{3}{4}$ inch. It occurs on pine and spruce in May and June. Several species of Dicerca, brassy metallic beetles about $\frac{1}{2}$ inch long, are found on pines and probably other evergreens in midsummer. Several species of Chrysobothris, notably *C. pusilla* Lap. and Gory, are very common on pines in midsummer. The larvæ of all of these flat-headed pine borers are of the well-known flat-headed type and work in the inner bark or the sapwood, excavating irregular sinuous channels and usually confining their operations to somewhat sickly trees or parts of trees.

FIG. 185.—Adult of flat-headed borer, Buprestis fasciata, enlarged.

The banded Buprestid, *Buprestis fasciata* Fabr. (Fig. 185), is a handsome, brilliant green, golden-yellow, flat beetle about 1/2 inch long, the larva of which works in maple. It has also been recorded as abundant on poplar.

Buprestis maculiventris Say is a large, metallic, flattened, oval beetle about 3/4 inch long. It occurs on balsam and spruce in June and July and has been reared from pine.

Chrysobothris azurea Lec. is a small flattened, brilliantly colored, purplish or bluish beetle about 1/4 inch long, which occurs in May on birch and other deciduous trees. It may be recognized by the three sparkling blue depressions on each purplish wing-cover. *C. dentipes* Germ. (Fig. 186) is common on pine.

FIG. 186.—Adult of flat-headed borer, Chrysobothris dentipes, enlarged.

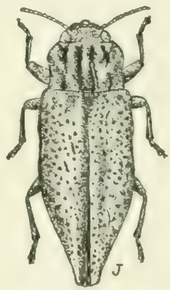

FIG. 187.—Adult of flat-headed borer, Dicerca punctulata, enlarged.

Divaricated Buprestis, *Dicerca divaricata* Say, is a flat brassy beetle a little less than an inch long, with the wing-covers divergent at the tips. It attacks a large number of deciduous trees, including beech and maple. The related coppery *D. punctulata* Schon. (Fig. 187) occurs on pitch pine.

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1917, Burke, H. E., Notes on Some Western Buprestidæ, Econ. Ent. Journ. 10: 325.
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1919, Burke, H. E., Biological Notes on Some Flat-Headed Bark Borers of the Genus Melanophila, Econ. Ent. Journ. 12: 103.
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Coccinellidæ, lady beetles.

Lady beetles or lady-bugs are very common on trees and shrubs in midsummer and usually indicate a serious infestation with plant-lice. These moderate to small insects are more or less hemispherical in shape, sometimes a little more oval in outline and then are usually less convex. Both the beetles and the grubs of this group feed on plant-lice, some species being well known because of their preying upon scale insects. The two-spotted lady beetle, *Adalia bipunctata* Linn., and the twice-stabbed lady beetle, *Chilocerus bivulnerus* Muls., are two very common beneficial species. A long series belonging to this group makes it impossible to notice all and consequently only two brief accounts are given below.

Fifteen-spotted lady beetle, *Anatis quinquedecimpunctata* Oliv. (Fig. 188), is one of the largest and most common lady beetles on various trees infested with plant-lice. The spiny black grubs also feed on aphids and are likewise beneficial.

Nine-spotted lady beetle, *Coccinella novemnotata* Herbst., is a small, yellowish, nine-spotted beetle, which occurs rather commonly on hard pines late in the season. The three-banded lady beetle, *C. perplexa* Muls., is frequently associated with the preceding.

Fig. 188.—Fifteen-spotted lady beetle, light and dark form, enlarged.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 604, 691.

Cucujidæ, Cucujids.

These beetles are very flat, usually elongated, mostly brown, although some are bright red. Many species live under bark and are believed to be carnivorous, both as adults and larvæ, while some occur in granaries and among stored food products.

Calitys scabra Thunb. (Fig. 189) is a flattened reddish beetle about $3/8$ inch long which is rather common in June on certain fungi growing from the ends of decaying hemlock logs. A related species, *Phellopsis obcordata* Kirby, occurs under similar conditions.

Fig. 189.—Calitys scabra, enlarged.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, p. 496.

Tenebrionidæ.

These beetles are mostly black or dark brown, oblong or oval in shape with a peculiar somewhat loosely jointed appearance and long rather clumsy awkward legs. The antennæ are generally bead-like and the mouth-parts small. The insects feed mostly on fungi or under bark, although in the desert regions of the West they are found on the ground beneath covers of any kind. The larvæ or grubs are long and slender with the body often flattened somewhat like that of a wire-worm and of a hard horny texture. They are mostly scavengers living in dead or decaying wood and dry vegetable products.

The forked fungus beetle, *Bolitotherus cornutus* Panz. (Fig. 190), is a very striking insect occurring on fungus growing on beech and maple in June. The male is remarkable for the greatly produced somewhat clubbed processes on the prothorax.

Hoplocephala bicornis Oliv. (Fig. 191) is a small rather stout greenish beetle about ⅛ inch long which may be recognized easily by the two conspicuous horn-like processes on the front. This species breeds in April and May on fungi occurring upon maple and beech.

Fig. 190.—Forked fungus beetle, male left, female right, enlarged.

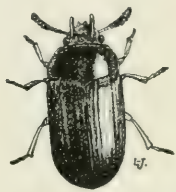

Fig. 191.—Hoplocephala bicornis, enlarged.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, p. 498.

Melandryidæ, Melandryid bark-beetles.

These insects are usually elongated and loosely jointed with the thorax margined at the side, broad behind and often marked with two basal impressions. They vary much in form and size and occur beneath bark or in dry fungi. They are often thickly clothed with fine silken hairs.

The slender, whitish, wood-boring grub of the blazed tree-borer, *Serropalpus barbatus* Schall, enters the wounds on living trees and bores deeply into the sapwood and heartwood. It is recorded as common in blazed wood on balsam, fir and spruce.

REFERENCE

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, p. 671.

Scarabæidæ, leaf-chafers, June beetles, and the like.

The members of this very large family vary greatly in size, form and habits, although all have a characteristic club com-

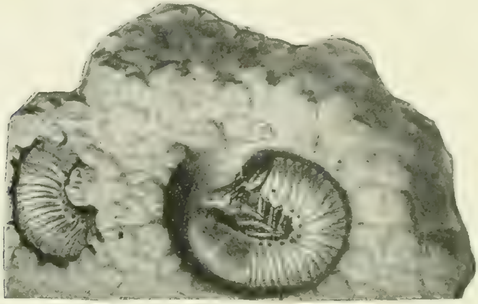

FIG. 192.—White grubs in underground cells.

posed of three to seven leaves or lamellæ at the tip of the antenna. Most of the insects grouped here are short, convex and stout-bodied, the well-known May or June beetles being

Fig. 193.—Light-loving grapevine beetle. Anomala lucicola, very common on pine.

typical. One group, the dung beetles or scavengers, live on putrefying or decomposing matter, and the larger, the leaf-chafers, feed either upon the leaves of trees or the pollen and petals of flowers.

The larvæ or grubs are either white or yellowish and with a brown horny head bearing prominent mandibles. The body is usually much wrinkled and enlarged toward the posterior extremity and when at rest the grubs lie on one side in a partly coiled position, the tip of the abdomen almost touching the long spiny legs.


Fig. 194.—Spotted grapevine beetle, enlarged.

The grubs of the May or June beetles, *Phyllophaga* spp., are primarily grass-root-eating insects. They occasionally become excessively abundant and may destroy the roots of young trees. The parent beetles issue in large numbers and feed for a time on the foliage of near-by trees; the northeastern species typified by *P. fusca* Froh. (Fig. 192) and associated forms display a marked preference, about in the order listed, for the foliage of the following trees: oak, ash, hickory, butternut or black walnut, elm and birch. Some of the smaller forms, as *Anomala lucicola* Fabr. (Fig. 193), are sometimes exceedingly abundant and injurious to the foliage of various trees and shrubs.


Fig. 195.—Dichelonycha albicollis, enlarged.

The rose beetle, *Macrodactylus subspinosus* Fabr., noticed elsewhere, is a well-known pest belonging to this family. The goldsmith beetle, *Cotalpa lanigera* Linn., the spotted grapevine beetle, *Pelidnota punctata* Linn. (Fig. 194), and the western white-lined Scarabæids, *Polyphylla decemlineata* Say and *P. crinita* Lec., are some of the larger and more striking.

Serica trociformis Burm. is a small, stout, brown and black beetle a trifle less than ¼ inch long which is common on scrub oaks in June. It may be recognized by its black head, very dark thorax and brick red rather deeply striated wing-covers.

Dichelonycha albicollis Burm. (Fig. 195) is a greenish, coppery, somewhat elongate, parallel-sided beetle about ½ inch long which occurs rather sparsely on hard pine in midsummer.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 514, 694.

Cerambycidæ, long-horned beetles.

The numerous rather oblong or elongate more or less cylindrical beetles belonging in this group have very long antennæ, these latter with few exceptions being much longer than the head and thorax and often longer than the entire body. These insects are strong fliers, have long legs and are swift runners. Many remain motionless on trees for long intervals and frequently can be picked up, although some voice resentment by an indignant squeaking produced by rubbing the prothorax and mesothorax together. The colors are variable, often very pretty, and the beetles are great favorites with collectors. Dead logs and recently cut timbers or lumber are much favored by these insects, although some species attack living trees.

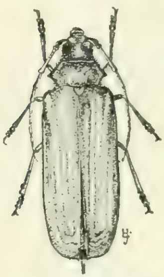

Fig. 196.—Harris's prionus.

The larvæ or grubs are white or yellowish legless borers with the body tapering slightly from the head to the posterior extremity. A few live in sapwood, although most work in dead or dying trees and some mine the inner bark in such a way as to loosen it from the wood. The grubs are not flattened like those of the metallic wood-borers and are usually spoken of as round-headed borers. Two or three years are required by some species to complete the life cycle. The sugar maple borer, the locust borer and the poplar borer, all noticed elsewhere, are among the more destructive species belonging in this group.

Harris's prionus, *Tragosoma harrisii* Lec. (Fig. 196), is a large stout brownish beetle about 1¼ inches long, which breeds in pine stumps and is credited with an extended distribution.

Lesser pine borer, *Asemum mæstum* Hald. (Fig. 197), a blackish-brown beetle ½ to ⅝ inch long, occurs late in May on pine. The grubs make flattened cylindrical holes or mines which perforate in all directions the trunk of white pine and other trees. It has also been recorded from spruce, oak and grape.

Fig. 197.—Lesser pine borer, enlarged.

Fig. 198.—Tetropium cinnamopterum, enlarged.

Tetropium cinnamopterum Kirby (Fig. 198) is a somewhat cylindrical black or brownish beetle about ½ inch long which occurs rather commonly in July on spruce. It infests the green bark and wood of injured and dying spruce.

Criocephalus agrestis Kirby is a large brownish-black narrow beetle about 1 inch long which occurs on pine in June and July. It is recorded as widely distributed and bores in the roots of pine and spruce.

Four-marked ash borer, *Eburia quadrigeminata* Say, is a light brown beetle about ¾ inch long and peculiar in having at the base and near the middle of each wing-cover pairs of ivory-like oval elevations. The grub bores in ash, hickory and honey locust.

The stout, brownish, gray-spotted beetle an inch long of the dusty oak borer, *Romaleum atomarium* Drury, is frequently reared from oak, walnut, hickory, cherry and even the dry leaf-stems of palmetto. The larvæ are recorded from stumps and logs of recently killed oak.

The numerous slender flattened tortuous galleries in ash $\frac{1}{16}$ to about $\frac{1}{8}$ inch in width and cutting the wood largely are very likely produced by the grub of *Obrium rubrum* Newman. This adult is a flattened reddish or rufus beetle about $\frac{1}{4}$ inch long and noteworthy for its long slender antenna.

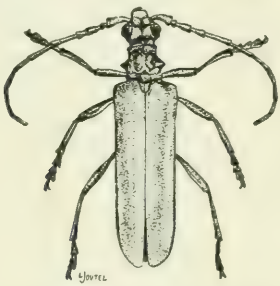

FIG. 199.—Centrodera decolorata, enlarged.

FIG. 200.—Gaurotes cyanipennis, enlarged.

Centrodera decolorata Harris (Fig. 199) is a slender light brown beetle about an inch long which bores in butternut and beech.

The grubs of *Gaurotes cyanipennis* Say (Fig. 200), a red-horned, red-legged, black, brilliant greenish beetle about $\frac{1}{2}$ inch long, work in white heart hickory and probably butternut. The beetles frequent sumac blossoms.

Anthophilax attenuatus Hald. (Fig. 201) is an olive-gray mottled beetle with black head and thorax and about $\frac{5}{8}$ inch long. It occurs in early spring on partly decayed beech stumps.

Canadian Leptura, *Leptura canadensis* Fabr., is a large handsome black beetle about ¾ inch long with the basal portion of the wing-covers deep red and the middle antennal joint broadly ringed with reddish. The grubs work under spruce and hemlock bark, the adults occurring in midsummer.

Leptura subhamata Rand. (Fig. 202) is a rather slender somewhat triangular black beetle about ½ inch long and with conspicuous yellowish markings. It occurs in midsummer on hemlock and has been taken on oak and beech.

FIG. 201.—Anthophilax attenuatus, enlarged.

FIG. 202.—Leptura subhamata, enlarged.

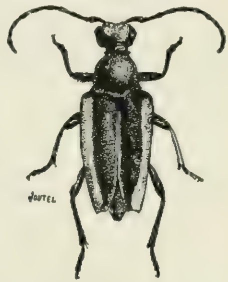

FIG. 203.—Leptura vagans, enlarged.

Leptura vagans Oliv. (Fig. 203) is a black beetle about ⅜ inch long, variably marked with dark orange, and occurs in midsummer on oak.

The grubs of this beautiful black golden-marked beetle, *Leptura zebra* Oliv. (Fig. 204), are about ⅝ inch long and bore in living chestnut bark.

Bellamira scalaris Say is a slender brownish beetle ranging from about ¾ inch to nearly 1¼ inches in length and lives as a larva under the bark of yellow birch. It has also been taken ovipositing on maple.

Typocerus velutinus Oliv. is a black beetle about ½ inch long with brick-red wing-covers marked with reddish-yellow spots. It occurs on scrub oak in July and is a common species.

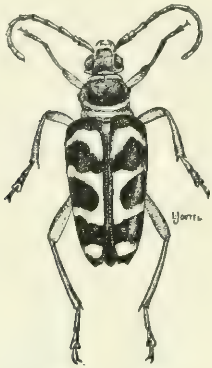

FIG. 204.—Leptura zebra, enlarged.

FIG. 205.—Physocnemum brevilineum, enlarged.

Physocnemum brevilineum Say (Fig. 205) is a rather stout black beetle nearly ½ inch long with brownish or bluish-purple wing-covers, each ornamented with four rather short whitish lines. The legs are somewhat long and the femora remarkable on account of their being greatly swollen toward the apex. It is a somewhat common elm borer.

FIG. 206.—Blue pine borer, enlarged.

Cedar tree borer, *Hylotrupes ligneus* Fabr., is a brownish beetle about ½ inch long with two large blue patches at the base of the wings and a broad yellowish band near the apical third. The grubs work in the bark and surface of the wood of living arbor-vitæ, causing the death of the tree and serious defects in the wood.

Callidium æreum Newm. is a brownish flattened beetle about ½ inch long. It mines as a larva the inner bark of chestnut and presumably hastens or even causes the death of aged or injured trees.

Fig. 207.—Blue pine borer, early work; the small galleries are the work of Pityophthorus.

Blue pine borer, *Callidium antennatum* Newm. (Figs. 206, 207), is a bluish flat beetle about ½ inch long. It is one of the more common pine borers, the larvæ being associated with the very badly eroded wood of pine branches about 2 inches in diameter and the beetles frequently issuing in some numbers from lumber in recently constructed dwellings. It also bores in spruce.

Phymatodes dimidiatus Kirby (Fig. 208) is a black red-shouldered flattened beetle about 5/16 inch long. It occurs in midsummer on spruce. This insect occasionally issues from manufactured lumber and is widely distributed.

The grubs of this rather slender, slightly flattened beetle about ½ inch long, the variable oak borer, *Phymatodes variabilis* Fabr., and with red prothorax and bluish wing-covers, mine the inner bark of dead and dying oaks and are also injurious to tan bark.

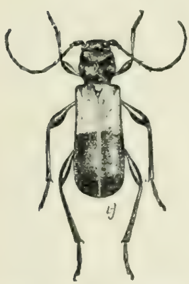

Fig. 208.—Phymatodes dimidiatus, enlarged.

Thunderbolt beetle, *Arhopalus fulminans* Fabr., is rather slender, blackish gray and about 5/8 inch long. As a larva it mines the inner bark and sapwood of chestnut and oak. It occurs throughout the early part of the summer.

Calloides nobilis Say is a stout black beetle about an inch long. It may be recognized easily by the three broad yellow spots at the base of each wing-cover, the smallest being at the extreme margin,

Fig. 209.—Xylotrechus undulatus, enlarged.

Fig. 210.—Euderces picipes, enlarged.

in connection with the two somewhat transverse lines of the same color across the apical half. It occurs on chestnut, oak and hickory and presumably has habits similar to the closely related sugar maple borer, *Glycobius speciosus* Say.

Fig. 211.—Dorcaschema nigrum, enlarged.

Xylotrechus undulatus Say (Fig. 209) is a beautiful cylindrical brownish beetle about ½ inch long and ornamented with sulfur-yellow markings. It occurs on both hemlock and spruce in midsummer and is widely distributed.

Euderces picipes Fabr. (Fig. 210) is a small jet-black beetle about ¼ inch long, with an oblique white line on each side just before the middle of the wing-covers and greatly swollen femora. The beetle presents a somewhat general resemblance to an ant. The grubs bore in hickory and chestnut branches.

Dorcaschema nigrum Say (Fig. 211) is a black slender cylindrical beetle about ⅜ inch long. It is rather commonly reared from hickory twigs. It appears to be widely distributed.

FIG. 212.—Acanthoderes decipiens, enlarged.

Beautiful hickory borer, *Goes pulchra* Hald., is a stout beetle about an inch long, beautifully marked with dark brown, silvery and reddish-yellow, there being a broad transverse lighter band across the wing-covers, the tips of which are conspicuous on account of the golden pubescence. The work of the grubs in young hickories causes the trunk to enlarge and produces a gall-like swelling and structural weakness.

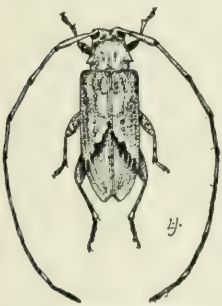

FIG. 213.—Leiopus alpha, enlarged.

Acanthoderes decipiens Hald. (Fig. 212) is a rather stout blackish beetle about ½ inch long and irregularly marked with gray. It occurs in June on poplar and hickory.

The grubs of prickly leptostylus, *Leptostylus aculiferus* Say, a small brownish-gray beetle only about ⅓ inch long, resemble young apple borers and sometimes occur in large numbers under the bark of apple and maple trees, making winding gradually expanding galleries. They have also been recorded from sweet gum, oak, osage orange and poplar trees.

Leiopus alpha Say (Fig. 213) is a moderately stout grayish beetle only about ¼ inch long, remarkable for the long delicate antennæ. The legless grubs make irregular galleries in dead sumac and other twigs.

Leiopus punctatus Lec. is a brownish-gray beetle about $\frac{3}{16}$ inch long, remarkable for the very long slender antennæ. It occurs in June on oak and is a somewhat rare species. It has also been recorded from flowering dogwood and plum.

Lepturges querci Fitch is a small, black, yellowish-gray beetle nearly $\frac{1}{4}$ inch long which may be reared in May and June from the limbs of hickory, oak and other trees. The slender antennæ are nearly twice the length of the body.

FIG. 214.—Hyperplatys maculatus, enlarged.

Hyperplatys maculatus Hald. (Fig. 214) is a small grayish black-spotted beetle about $\frac{1}{4}$ inch long with extremely slender black antennæ. It bores the dead twigs of oaks and other trees and has been recorded from orange, apple, hickory, poplar, oak, maple, elm, locust, beech and sumac.

Urographis fasciatus DeGeer is a stout, brown, grayish-mottled beetle about $\frac{1}{2}$ inch long which occurs in midsummer on oak and various other trees, having been recorded in addition from hickory, chestnut, beech, apple, pear and pine. It appears to prefer oak.

Graphisurus obsoletus Oliv. is a grayish-brown mottled beetle about $\frac{5}{16}$ to $\frac{1}{2}$ inch long, occurring on white pine. The female is remarkable because of her long ovipositor, which extends some $\frac{3}{8}$ inch beyond the tip of the abdomen. The adults are abroad during July and August.

The larva of *Saperda concolor* Lec., a cylindrical slaty-gray beetle about $\frac{3}{8}$ inch long, girdles the trunks of sapling poplars and causes a swelling twice the diameter of the tree. The beetles are abroad from the last of May until toward the end of June.

The stems of alder are frequently deformed by irregular gall-like swellings resulting from the partial girdling by the larvæ of the alder borer, *Saperda obliqua* Say, a light reddish-brown beetle about ¾ inch long and with dark brown depressed bands on the wing-covers.

Saperda populnea Linn. is a small, brown or black, coarsely punctured, European beetle about ½ inch long. It produces galls in balsam poplar. One variety is western and another eastern.

Woodbine borer, *Saperda puncticollis* Say, is a jet-black bright yellow-marked beetle almost ½ inch long, the grub of which bores in woodbine, sumac and possibly poison ivy.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 431–676.

Chrysomelidæ, leaf-beetles.

This is a very large family of medium or small-sized beetles usually with short bodies and a more or less oval outline. The antennæ are moderately long, the legs short and the insects are often prettily variegated, although some are a uniform metallic blue or green and others dull brown or black.

The yellowish eggs are usually deposited upon the leaves and the frequently fleshy, convex, chunky, hump-back slugs or grubs, as, for example, the young of the Colorado potato beetle and those of the elm leaf-beetle, feed on the foliage. Those exposed to the light are more or less highly colored, some are flattened and curiously armed with spines, while a few cover themselves partially with their own excrement. Some leaf-miners or stem-borers are long and slender; the grubs of one large group are case-bearers and those of an entire tribe are root-feeders.

This family is very important since it contains some of the most destructive insects, such as asparagus beetles, striped cucumber beetles, the elm leaf-beetle and a number of injurious flea-beetles.

Fig. 215.—Cryptocephalus quadrimaculatus, enlarged.

Two species of Cryptocephalus, each only ⅛ inch long, occur on hard pines in midsummer. *C. schreibersii* Suffr. is a uniform yellowish-brown, while *C. quadrimaculata* Say (Fig. 215) is a somewhat stouter black red-spotted beetle. The latter is also known to occur on New Jersey tea and Rubus.

Glyptoscelis trifasciata Linn. (Fig. 216) is a small shining black beetle about ¼ inch long with four irregular orange markings on the wing-covers. It is found in the galleries of various wood-borers, particularly those with exuding sap.

Metachroma marginalis Crotch is a light brown beetle less than ⅓ inch long. It is rather common on hard pine in midsummer, though it does not appear to be particularly injurious. The larvæ are probably root-feeders.

Fig. 216.—Glyptoscelis trifasciata, enlarged.

Typophorus canellus Fabr. (Fig. 217) is a small, roundish, brown and black-marked beetle about $\frac{1}{16}$ inch long, which occurs in May and early fall on butternut, mountain ash and various plants. The beetles eat irregular oval or elongate holes in the foliage.

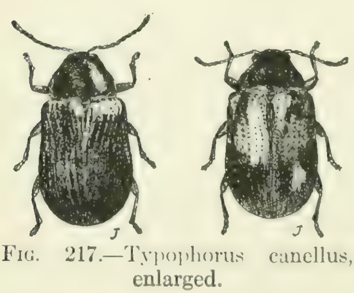

Fig. 217.—Typophorus canellus, enlarged.

Poplar leaf-beetle, *Phytodecta pallida* Linn. (Fig. 218), is a pale brown black-spotted beetle about ¼ inch long, which is occasionally destructive to willow and poplar in early June.

Chrysomela bigsbyana Kirby is a yellowish black-marked hemispheric beetle about 1/4 inch long. It feeds the latter part of the summer on willows and hard pines.

Alder leaf-beetle, *Chrysomela scalaris* Lec., is a rather stout, brilliant, bottle-green, oval beetle about 1/8 inch long and with silvery-white wing-covers ornamented with several conspicuous green spots and a median jagged stripe of the same color. It feeds on the leaves of elm, linden, willow and alder throughout the season. The over-wintering beetles are abroad from May to June and those of the second brood may be found in September and October.

Fig. 218.—Poplar leaf-beetle, enlarged.

Cherry leaf-beetle, *Galerucella cavicollis* Lec., is a small red leaf-beetle about 1/5 inch long. It is abroad in midsummer and eats irregular round holes in the leaves of wild cherry, occasionally becoming extremely abundant, especially in the Adirondacks.

Fig. 219.—Dull red willow leaf-beetle, enlarged.

Dull red willow leaf-beetle, *Galerucella decora* Say (Fig. 219), is a dull yellow or dusky-brown beetle about 1/5 inch long. It is very abundant and occasionally somewhat injurious to willow. It is closely related to our imported elm leaf-beetle.

Willow leaf-beetle, *Disonycha caroliniana* Fabr., is a striped, rather stout, black and yellow beetle about 1/4 inch long, occurring in June on willow, the larvæ becoming full grown in early August.

Red-footed leaf-beetle, *Crepidodera rufipes* Linn., is a red-headed blue flea-beetle about 1/8 inch long which is sometimes very abundant on locust and apple foliage in early spring.

Black-margined flea-beetle, *Systena marginalis* Illiger, is yellowish-brown, black-margined, and about $^3\!/_{16}$ inch long. It feeds commonly and sometimes in great numbers during the summer and autumn on oak, hickory and birch.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 515–695.

Curculionidæ, curculios or weevils.

Beetles of this family have on the lower side of each wing-cover a strong fold near the outer margin which limits a large groove in which the outer edge of the abdomen fits. The mandibles have no scar. The antennæ are usually elbowed and have a ring or solid club. The grubs are white, soft, footless and maggot-like. They feed chiefly on fruits, seeds and nuts, although all parts of the plant are subject to attack.

The destructive white pine weevil and the nut weevils, all noticed elsewhere, are probably the best known members of this large and very important family.

New York weevil, *Ithycerus noveboracensis* Forst., is a large grayish insect about $^1\!/_2$ inch long. It occurs on the buds of a variety of trees from May to June, having been recorded from oak, hickory and beech. The beetles eat into the buds and gnaw into the twigs, chiefly at the base, thus causing them to break and fall. The grubs are borers in twigs and tender branches of oak and hickory.

Two-spotted curculio, *Attelabus bipustulatus* Fabr., is a rather stout highly polished black beetle about $^3\!/_{16}$ inch long and with two large orange-red spots at the base of the wing-covers. It is most interesting because of its habit of rolling the terminal oak leaves into neat cylindrical cases containing an egg. The species is widely distributed, although rarely numerous.

Attelabus rhois Boh., a dull reddish beetle, has the body clothed with short yellowish down and is about $^1\!/_5$ inch long.

It is noteworthy because it deposits eggs in June and July in peculiar thimble-like rolls of leaves on alder, hazel and sumac.

Gray-sided oak weevil, *Pandeletejus hilaris* Herbst (Fig. 200), is small and grayish, $\frac{1}{8}$ to $\frac{3}{16}$ inch long. It occurs on oak foliage from May to September, the larvæ tunneling in the wood.

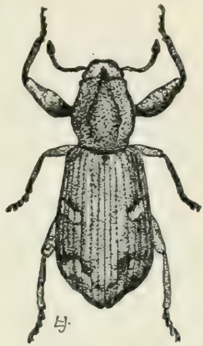

FIG. 220.—Gray-sided oak weevil, enlarged.

Dorytomus parvicollis Casey, a small brownish-black yellow-specked weevil about $\frac{1}{4}$ inch long, is sometimes very abundant in early spring under the loose bark of poplars. A smaller species, *D. vagenotatus* Casey, about $\frac{1}{8}$ inch long, is found in much smaller numbers under similar conditions.

Elleschus ephippiatus Say is a small brownish long-snouted beetle $\frac{1}{3}$ to nearly $\frac{1}{2}$ inch long and thickly clothed with golden and brownish pubescence. It occurs in considerable numbers on willow in early spring.

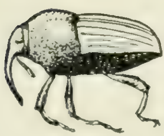

FIG. 221.—Madarellus undulatus, enlarged.

FIG. 222.—Cossonus platalea, enlarged.

Madarellus undulatus Say (Fig. 221) is a stout, jet-black, highly polished curculio with deeply striated wing-covers, about 1/8 inch long. It occurs on Virginia creeper, poison ivy and grape.

Cossonus platalea Say (Fig. 222) is a flattened, jet-black, snout-beetle about 1/4 inch long which occasionally is found in large numbers in butternut, poplar and other woods, where it makes numerous irregular galleries, the beetles issuing in early May.

Fig. 223.—Fruit-tree bark-beetle, work in apple.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 436–574.

Ipidæ, bark- or engraver-beetles, timber beetles.

These are all mostly small cylindrical beetles. The larger ones rarely exceed 1/4 inch in length and there are numerous smaller almost microscopic forms. The prevailing color is brown, sometimes black. The posterior extremity of the body is very blunt as though cut off and in some species curiously toothed. The insects are most easily recognized by the characteristic galleries or borings and many of the more important species are noticed under the general term bark-borers and timber beetles, pages 241–280, so named because the former work mostly under the bark and the latter in the wood, even penetrating to considerable depths.

Fruit-tree bark-beetle, *Scolytus rugulosus* Ratz. (Fig. 223), is best known as a fruit-tree pest, although it occasionally attacks wild cherry. It is a dark brown, oblique, stout bark-beetle about 1/8 inch long.

Peach bark-beetle, *Phlœotribus liminaris* Harris, is minute, brownish, rather stout, about $\frac{1}{10}$ inch long. It is better known as a fruit-tree pest, although it occasionally attacks wild cherry, probably plum and related trees.

Pine Hylurgops, *Hylurgops glabratus* Zett. (Fig. 224), is a stout, brownish bark-beetle about $\frac{3}{16}$ inch long, which works under pine bark during early spring and again in September. It is recorded from pine lumber in mill yards and also in the bark of white pine stumps.


Fig. 224.—Pine Hylurgops, enlarged.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 452–453, 665–666.

Lepidoptera

Butterflies and Moths

The butterflies and moths are easily recognized by the four membranous wings (a few species are wingless) covered with over-lapping scales, the sucking mouth-parts and a complete transformation or metamorphosis.

This group is one of the most important to the forester, since it includes a considerable number of leaf-eating caterpillars which defoliate many trees, some becoming so enormously abundant as to strip the foliage from large areas.

The larvæ or young of both butterflies and moths are the common caterpillars so frequently seen and incorrectly termed worms. They are usually cylindrical and provided with eight to sixteen legs. The six thoracic legs, almost invariably present, are hard and jointed, while those of the abdomen, two to ten in number, are simple fleshy processes, usually with numerous minute hooks at the tips and are known as false legs or pro-legs.

Rhopalocera, butterflies.

The butterflies differ from the moths in that no cocoon is spun, and the pupa, generally known as a chrysalis, is attached to some support and steadied by a band or belt of silk. The chrysalids frequently harmonize with their surroundings and a few are highly colored. Butterflies almost invariably rest with the wings in a vertical position, and they are furthermore distinguished by the distinct knob or club at the tip of the antenna.

Ordinarily butterfly caterpillars are not sufficiently abundant to cause extensive injuries, marked exceptions being the eastern spiny elm caterpillar, *Euvanessa antiopa* Linn., and the western pine butterfly caterpillar, *Neophasia menapia* Feld.

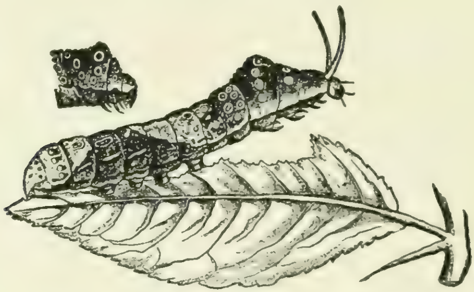

FIG. 225.—Orange dog, reduced slightly.

The caterpillar of the orange dog, *Papilio thoas* Linn. (Fig. 225), is large and brownish with conspicuous annular cream-colored markings on its middle and at its posterior extremity. It is sometimes rather abundant on prickly ash. It is about $2\frac{1}{2}$ inches long when full grown. There are two generations of this butterfly in the northern area and about four in its southern range.

There are three species of smaller spiny elm caterpillars, *Polygonia* spp., related to the much more abundant and distinctly larger spiny elm caterpillar, *Euvanessa antiopa* Linn. (Fig. 226), which may be found feeding on elm in early spring and again in August. These are the larvæ of the violet tip, *P. interrogationis* Fabr., the hop merchant, *P. comma* Harr.

and the Gray comma, *P. progne* Cram., the second being well known as a pest in hop yards.

The large pale green caterpillars of the locust leaf-folder, *Epargyreus tityrus* Fabr., are about 2 inches long when full grown, with a red neck and a large red head with a yellow

FIG. 226.—Mourning cloak butterfly, parent of spiny elm caterpillar.

spot on each side above the mouth. They draw the leaves of the locust together and feed at night during July.

REFERENCE

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 544–557.

Heterocera, moths.

This suborder comprises an extremely large and varied series of Lepidoptera most easily distinguished from the butterflies or Rhopalocera by the fact that the antennæ, although exceedingly varied in structure, do not have a knob or club at the tip. Very few moths rest with the wings in the characteristic vertical position of butterflies. This suborder presents great extremes in size, some of the largest and many extremely small species belonging here. A very large proportion of the more destructive leaf-eating caterpillars belong in this subfamily.

Sphingidæ, hawk or sphinx moths.

The insects grouped here have stout spindle-shaped bodies, long, narrow and strong wings and the antennæ are more or less thickened in the middle or toward the tip, which latter is frequently recurved.

Fig. 227.—Humming-bird moth, Hemaris diffinis.

The common name of humming-bird moths (Fig. 227) has been given to certain members of this group on account of their rapid darting flight and the habit of remaining poised in the air over flowers. Some of the brighter-colored, clear-winged species fly in midday, although most are on the wing in early twilight.

Fig. 228.—Sphinx caterpillar.

The larvæ are large stout-bodied caterpillars frequently 3 inches or more in length and usually with a curved horn or process near the posterior extremity or in place of this a polished eye-like spot (Figs. 228, 229). They may rest with the head and anterior body segments elevated and when in this position suggest the "sphinx," a name used in earlier years for members of this family. The common "green worms" of the tomato and potato are typical of the group.

The stout apple-green caterpillar of the ash sphinx, *Sphinx kalmiæ* Abb. and Sm., is about 3 inches long, has seven oblique stripes on each side and a light blue caudal horn. It feeds on the leaves of ash, lilac and mountain laurel.

Four-lined sphinx, *Ceratomia amyntor* Hubn., is a stout, pale green, reddish-brown larva about 3 inches long, with a

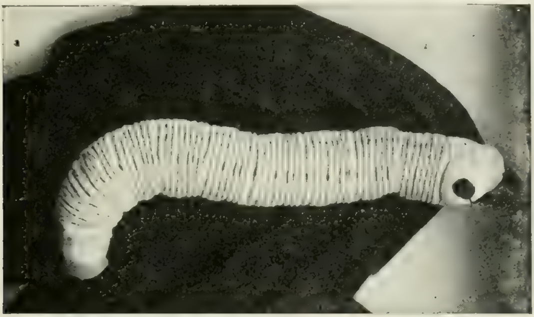

FIG. 229.—Virginia creeper worm.

conspicuous caudal horn and four large tubercle-like elevations on the thoracic segments. This insect occurs in September on elm, beech, linden and probably ash. It is ordinarily not particularly abundant.

The variably light green caterpillar of the wavy sphinx, *Ceratomia undulosa* Walk., is about 1¾ inches long when full grown and has reddish legs, a caudal horn and a series of seven oblique whitish stripes on each side of the body. It feeds on the foliage of white and black ash, lilac and privet.

Harris's pine hawk moth, *Lapara bombycoides* Walk., has a grass-green, yellow and white-striped caterpillar, 2 to 2½ inches long when full grown, which feeds on pine in the middle of September, the moths appearing the following June. The linear markings of the larvæ are such as to conceal it somewhat effectively as it rests among the pine needles.

Walnut sphinx, *Cressonia juglandis* Abb. and Sm., is a stout, light apple-green caterpillar, with a prominent horn at its posterior extremity and ornamented with seven oblique stripes on each side. It feeds on the leaves of hickory, black walnut and ironwood and has been recorded as occurring on wild cherry. The full-grown caterpillar is about 2½ inches long.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 518–519, 546, 548, 679.

Saturniidæ, giant silk-worms.

This family includes some of the larger moths, such as Cecropia, Luna and Polyphemus. All are heavy-bodied and

FIG. 230.—Promethea caterpillars.

broad-winged, with beautifully plumed or pectinate antennæ in the male. The caterpillars are variously armed with tubercles and spines and the winter is passed in large silken cocoons.

Promethea moth, *Callosamia promethea* Drury, feeds in midsummer on the foliage of a considerable number of trees and shrubs, being common on lilac. The large, delicate, bluish-white caterpillar (Fig. 230), with four large yellow or red tubercles on the posterior thoracic segments and large ones

Fig. 231.—Cecropia caterpillars.

on the dorsum of the eighth abdominal segment, is some 2½ inches long when full grown. The moderate-sized rather firm silken cocoons are constructed within a partly folded leaf and hang from the twigs through the winter.

Cecropia moth, *Samia cecropia* Linn., is one of the largest moths. The large pale green caterpillar about 4 inches long when full grown (Fig. 231) is ornamented with conspicuous blue, yellow and red tubercles and feeds on a large variety of trees and shrubs in midsummer.

The caterpillar of the American silk-worm, *Telea polyphemus* Hubn., is very large, pea green, with a brown head and small reddish-brown tubercles with silvered bases. It is about 3 inches long when full grown, occurs in midsummer on the foliage of a great variety of trees and is not abundant, as a

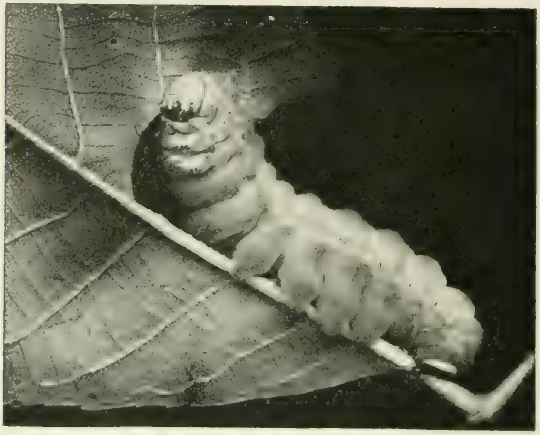

FIG. 232.—Luna caterpillar.

rule. The dull ocher-yellow moth with its wings shaded with innumerable black particles has a wing expanse of 5½ inches.

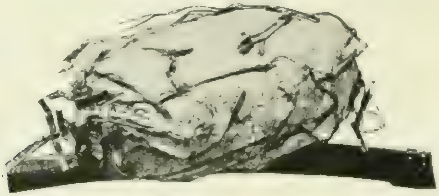

FIG. 233.—Luna cocoon.

Luna moth, *Tropea luna* Linn. (Figs. 232, 233), has a stout apple-green caterpillar about 3 inches long when full grown with six rows of small, pink, hairy tubercles. It occurs in midsummer on a considerable variety of trees. The moth is a magnificent light green long-tailed insect with a wing spread of about 4 inches.

FIG. 234.—Io caterpillar.

Io caterpillar, *Automeris io* Fabr. (Figs. 234, 235), is a large pale greenish stout caterpillar with delicate markings of yellowish-red and it is most easily recognized by the uniform rather thick clothing of groups of irritating, sharp, poisonous

FIG. 235.—Io moth.

spines. The full-grown caterpillar is about 2 inches long and feeds in late summer on the foliage of many trees. The earlier stages are somewhat gregarious.

The nearly black finely red-striped spined caterpillar of the western day moth, *Pseudohazis eglanterina* Boisd., is some 2 inches long when full grown. The eggs are laid in spring in clusters around small stems or branches. The larvæ feed on a great variety of both wild and cultivated trees and shrubs. The pupæ winter in the soil. The egg masses are easily destroyed by hand picking and the larvæ killed with an arsenical spray.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 521–557.
1915, Essig, E. O., Inj. Ben. Ins. Cal., pp. 388–389.

Ceratocampidæ, royal moths.

These are stout-bodied hairy moths with sunken heads and strong wings. They are of medium to large size, a few being among the largest. The wings are narrow and the antennæ less plumose or pectinate than among the moths of the related giant silk-worms.

The caterpillars feed on a variety of trees and shrubs and are variously armed with horns or spines, those on the second thoracic segment and sometimes those of the third being long and curved. The largest caterpillar, the hickory horned devil, *Citheronia regalis* Fabr., attains a length of 4 to 5 inches (Fig. 112).

Spiny oak worm, *Anisota stigma* Hubn., is rare in the northern states, although in the South it is frequently as destructive as the closely related *Anisota senatoria* of the northern states. This bright, tawny or orange-colored caterpillar with a dusky strip along its back and prominent spines on the thoracic segments feeds on oak in September. The related green-striped maple worm, *Anisota rubicunda* Fabr., is occasionally very abundant.

Imperial moth, *Basilona imperialis Drury* (Figs. 236, 237), has a large thick pale green caterpillar some 3 to 4 inches long when full grown with a pale orange head and legs and six spined yellowish tubercles behind the head. It occurs on white pine needles late in August and through September. The magnificent yellowish and purplish-brown spotted moth has a wing spread of some 5½ inches.

Fig. 236.—Imperial moth.

Fig. 237.—Imperial moth, larva.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 527, 678–679.
1908, Felt, E. P., N. Y. State Mus. Bull. 124, pp. 13–21.

Arctiidæ, tiger moths, tussock caterpillars.

The moths in this family are stout-bodied with moderately broad wings, most of the species being conspicuously striped or spotted. The larvæ are the familiar and sometimes very common woolly bears and in this group are certain hickory and oak tussock caterpillars. (See Fig. 114 for the general characteristics of the group.)

Oak tussock moth, *Halisidota maculata* Harris, shows a marked preference for oak, although it occurs also on poplar, willow and alder. This black-headed caterpillar about 1¼ inches long when full grown is thickly clothed with yellowish hairs with interspersed black tufts.

Pale tussock moth, *Halisidota tessellaris* Hubn., is a yellowish brown-headed caterpillar about 1¼ inches long when full grown and clothed with delicate tufts of yellow hairs and with four light brown dorsal pencils. It feeds in the fall on a large variety of trees.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 523–524.

Noctuidæ, owlet moths.

This is a very large group of dull-colored stout-bodied moths, the short, stiff, triangular fore-wings and the broader hind-wings being general distinguishing characters (Fig. 238). The larvæ of a number of species are the common and destructive cutworms of the garden. The exceedingly injurious cotton worm of the South, the corn ear-worm and the army-worm of the North all belong in this group. The caterpillars are naked, stout-bodied and of moderate size.

The long series of under-wings or Catocalas, easily recognized by their moderately large size, usually sombre coloring of the fore-wings and the bright frequently yellow or red-marked hind wings, belong here. The larvæ are likewise dull-colored, are peculiar in having an orange-colored dorsal fold, and both adults and larvæ present striking cases of protective resemblance.

White pine tufted caterpillar, *Panthea furcilla* Pack., occurs on pine during late August and in September. The dull red caterpillar banded with brighter red and with a light lateral line and reddish hairs in clusters attains a length of over 1½ inches.

Fig. 238.—Green maple worm, adult.

The rather large, yellowish, short-haired caterpillars of American dagger moth, *Apatela americana* Harris, are about 2½ inches long when full grown and bear a pair of long black hair pencils on the first and third abdominal segments and one on the eighth. This black-headed leaf caterpillar is a very general feeder on maple, elm, chestnut, oak and a number of other trees.

Smeared dagger moth, *Apatela oblinita* Abb. and Sm., is a black-headed velvety-black caterpillar usually with a conspicuous, somewhat broken, subdorsal yellow stripe and another along the stigmatal line. It occurs in September and October on poplar, willow, alder, button-bush and other deciduous trees.

Semilooper maple worm, *Homoptera lunata* Drury, is a drab-colored caterpillar about 1½ inches long with a large orange dorsal spot, which is exposed at the juncture of the first and second abdominal segments when the body is bent. It feeds on maple, oak, willow and rose in May and June, the moths appearing the last of June and in early July. A second generation of larvæ occur in August and September, the moths developing in November and living over winter.

The pretty yellowish or whitish long-haired caterpillar of *Apatelodes torrefacta* Abb. and Sm., has three dark hair pencils along the median line, one each on the second and third thoracic and the eighth abdominal segments. It attains a length of about 2 inches and occurs in midsummer on a great variety of food plants.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 525, 538, 549, 560, 679.

Notodontidæ, prominents.

These are moderate-sized moths presenting a general resemblance to the numerous owlet moths or Noctuidæ. The wings are strong, not very broad and with the anal angle of the hind-wings rarely extending to the tip of the abdomen.

The larvæ or caterpillars are naked or only sparsely haired, although they often have spines, spurs, humps or other processes and in some species of Harpyia (Fig. 239) the anal legs are produced posteriorly as a pair of slender processes resembling a long fork. The antlered maple caterpillar, *Heterocampa guttivitta* Walk., is one of the most destructive species in this family.

The black yellow-striped larvæ of poplar tent-maker, *Melalopha inclusa* Hubn., are about 1¼ inches long when full grown and have a pair of large black tubercles close together on the dorsum of the first and eighth abdominal segments. They feed in moderately large colonies within the folded webbed-together leaves of poplars and willows (Fig. 240).

The black, yellow-necked, yellow-striped caterpillars nearly 2 inches long of yellow-necked apple worm, *Datana ministra* Walk., occur in clusters during midsummer on the twigs of a variety of trees. The insect is best known as an apple pest, although the larvæ are general feeders, having been recorded on a considerable variety of forest trees.

Green oak caterpillar, *Nadata gibbosa* Abb. and Sm., is a pale greenish caterpillar about an inch long when full grown and with a more or less distinct yellowish lateral line. It has been recorded from oak, maple, white birch and sugar plum and ranges across the country. It is common, although rarely abundant.

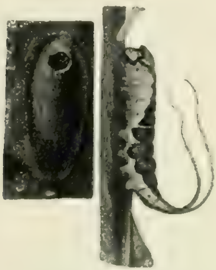

Fig. 239.—Harpyia species, showing long-tailed larva and cocoon.

Fig. 240.—Poplar tent-maker on its tent.

Red-humped oak caterpillar, *Symmerista albifrons* Abb. and Sm., is red-headed, striped, with a conspicuous red hump on the eighth abdominal segment and a series of yellow and black body lines on a pale lilac ground. It is easily recognized as one of the common late summer oak feeders. The eggs are laid on the underside of the leaves and the young caterpillars, at first gregarious, scatter over the tree after the first or second molt. They also feed on maple and beech.

The caterpillar of rosy hyparpax, *Hyparpax aurora* Abb.

and Sm., is about 1½ inches long when full grown, has a red head and conspicuous pointed elevations on the first and eighth abdominal segments and variably brown and yellowish or pinkish dorsal markings. It occurs on different species of oak during midsummer and has a rather striking appearance which is heightened by the caterpillar's habit of carrying its posterior extremity, with the slender extended pro-legs, elevated in the air.

REFERENCE

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 519–521, 535, 536, 560–561.

Liparidæ, tussock moths.

The caterpillars of the tussock moths are among the most brilliantly colored and beautifully ornamented larvæ with their characteristic tufts or pencils of long hairs at the extremities of the body and the shorter brush-like groups on the intervening segments. The destructive, native, white-marked tussock moth, *Hemerocampa leucostigma* Abb. and Sm. (Fig. 35), and the introduced gipsy moth, *Porthetria dispar* Hubn., belong in this group.

The moths of Liparidæ are relatively plain, frequently with shades of gray or brown and in Hemerocampa the females are grayish, wingless and almost grub-like in appearance.

Definite-marked tussock moth, *Hemerocampa definita* Pack., has a yellow-headed, light-yellowish tufted caterpillar resembling very closely that of the common white tussock moth. It feeds on the foliage of oak and a number of other trees.

The black-headed yellow or white tufted caterpillar of rusty tussock moth, *Notolophus antiqua* Linn., is about 1½ inches long when full grown. It is most easily recognized by the lateral black hair pencil on each side; otherwise it resembles closely the common white-marked tussock moth caterpillar. It feeds on most deciduous trees.

Dark tussock moth, *Olene achatina* Abb. and Sm., is a black-headed caterpillar clothed with grayish hairs and with two black hair pencils on the second segment and square tufts on segments five to seven. It is closely related to the rusty tussock moth and like it feeds on a considerable variety of forest trees.

The grayish caterpillars of California tussock moth, *Hemerocampa vetusta* Boisd., are 1½ to 2 inches long when full grown and have numerous colored spots, the four thick white dorsal tufts and the longer black pencil tufts at the extremities of the body. The eggs are deposited during May, June and July. They remain unhatched over winter, the young caterpillars feeding in the spring on the foliage of oak, black walnut and other trees and also injuring various fruits. Collecting egg masses and banding are recommended since the larvæ are very resistant to arsenical poisons.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 522–524.
1915, Essig, E. O., Inj. Ben. Ins. Cal., pp. 408–410.

Lasiocampidæ, lappet moths and tent-caterpillars.

These moths are stout-bodied, medium-sized and with the antennæ pectinate in both sexes. The wings are rather short and broad, very densely clothed and usually with pale or darker median lines, as in the Velleda lappet (Fig. 241).

Fig. 241.—Velleda lappet moth.

The lappet caterpillars are most interesting on account of the flattened shape and the fringed lateral processes enabling them when at rest to harmonize so closely with the surface as to be almost invisible.

Larch lappet, *Tolype laricis* Fitch, is recorded as feeding on pine, hemlock and larch and has been taken on plum and cherry. The dull, rusty brown, irregularly white spotted, flattened caterpillar with series of grayish tufts on each side harmonizes very closely with pine bark and is not easily detected when at rest, even though it be some three inches long. The cocoon also harmonizes very closely with the bark and is not easily seen.

The webbed tents of apple tent-caterpillar, *Malacosoma americana* Fabr., in the forks of wild cherry and apple trees in early spring, are so well known that little need be said, except that wild cherry is the favorite food and the usual breeding ground for the infestation of near-by orchards. This insect is closely related to the important woodland species, the forest tent-caterpillar, *Malacosoma disstria* Hubn.

American lappet moth, *Epicnaptera americana* Harris, is found on oak, ash and apple and is rarely abundant. This large, grayish, scarlet marked caterpillar about 2½ inches long is peculiar on account of the large bordering grayish fringes on each side, these greatly assisting in concealing the caterpillar when at rest on the bark of trees.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 525, 550, 680.

Geometridæ, measuring-worms.

The caterpillars of this long series of small or medium slender moths are known as measuring-worms and are easily recognized by their characteristic looping habit. They are also interesting because of their protective resemblance.

The moths have broad very delicate wings, the prevailing colors being shades of brown or gray and the markings linear or angular (Fig. 242). There are a number of destructive species in this family.

The yellow, black striped caterpillars of cherry scallop shell moth, *Hydria undulata* Linn., web together the leaves of wild cherry in July and August, producing brownish unsightly webby masses. The caterpillars attain full growth in August or September.

Fig. 242.—Ennomos magnarius.

Large maple spanworm, *Sabulodes transversata* Drury, is a large slender-bodied spanworm marked with dark purple, brown and red and about 1¾ inches long when full grown. It occurs on maples in July.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 539, 551.

Megalopygidæ, flannel moths.

These rather large moths have stout bodies and the wings clothed with long hairs. The larvæ are remarkable in the possession of an additional pair of abdominal legs, namely, seven. The cocoon is a curious case-like structure with a trap door at one end.

The peculiar, stout, somewhat flattened larva of crinkled flannel moth, *Lagoa crispata* Pack., attains an inch in length and is thickly covered with long mouse-gray and faun-colored hairs. It occurs in September on the foliage of a variety of plants, such as oak, elm, apple and raspberry.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 529–530.

Cochlidiidæ, slug caterpillars.

Peculiar, brightly colored, variously shaped and usually motionless, slug-like caterpillars, rarely an inch long, occur in midsummer on the foliage of various deciduous trees.

These very peculiar caterpillars are remarkable because of the apparent absence of legs and on account of their brilliant color in connection with more or less well-developed defensive armor. They vary widely in appearance, occur on a large number of trees and shrubs and are very rarely abundant enough to be regarded as anything more than natural curiosities. Some sting severely and thus call attention to themselves in a very unpleasant manner. Glands at the bases of the spines have been detected by European investigators who state that the hollow spines may be filled with formic acid or a formate in solution. A number of these peculiar larvæ are oval in shape, with the flattened surface closely appressed to the leaf, giving them the appearance of brightly colored very large scale insects or slugs. For brief accounts of a number of species see Felt, E. P., 1906, N. Y. State Mus. Mem. 8, vol. 2, pp. 527–529.

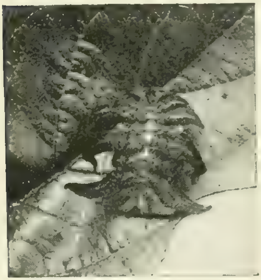

Fig. 243.—Hag moth caterpillar.

The hag moth caterpillar, *Phobetron pithecium* Abb. and Sm. (Fig. 243), is a brownish slug caterpillar about ¾ inch long and remarkable for the ten long tapering plume-like processes extending from either side of the back. It occurs on the foliage of a number of trees from July to September.

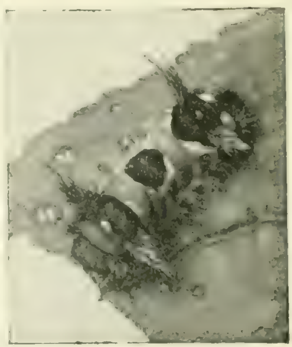

Fig. 244.—Saddleback caterpillar.

The saddleback caterpillar, *Sibine stimulea* Clem. (Fig. 244), is brownish, about 1 inch in length and apparently with a green saddle cloth on its back and a brownish saddle, the latter margined with white and edged with a black line. There are long brown-spined tubercles at both extremities. The larva occurs commonly on oak and cherry and is capable of inflicting a very severe sting.

Euclea indetermina Boisd. is from $\frac{5}{8}$ to $\frac{3}{4}$ inch long, oval, and with a series of six fiery red lines along the back on either side. It feeds on various low bushes and limbs of trees.

Euclea delphinii Boisd. is oval in shape, closely appressed to the leaf, greenish and variably marked with red and with pale orange subdorsal stripes. The full-grown larva is about $\frac{1}{2}$ inch long and occurs on a considerable variety of trees.

Oriental slug caterpillar, *Cnidocampa flavescens* Walk., is a European species. It is a general feeder and is well established in the vicinity of Boston, Massachusetts. The larva is about $\frac{3}{4}$ inch long, yellowish, red marked, blue spotted, green and greenish-brown and with groups of large spiny processes at both extremities. The cocoon is attached to twigs, oval, about $\frac{3}{4}$ inch long and with peculiar broad white markings.

References

1907, Fernald, H. T., Mass. Exp. Sta. Bull. 114.
1907, Fernald, H. T., and Summers, J. N., Ent. News 18: 321–327.
1907, Felt, E. P., N. Y. State Mus. Bull. 110, pp. 47–48.

Cossidæ, carpenter moths or wood-boring caterpillars.

These are mostly large moths with spindle-shaped bodies and narrow strong wings very suggestive of the Sphingidæ. The large wood-boring caterpillars of this family penetrate readily into the trunks of such trees as oak and maple and in some instances cause serious injury. The recently introduced leopard moth, *Zeuzera pyrina* Linn., belongs in this group.

Lesser oak carpenter worm, *Prionoxystus macmurtrei* Guer.-Men., is closely related to the larger and more common carpenter worm, *P. robiniæ* Peck. The brown-headed greenish larva with rose-colored elevated points is about 1½ inches long when full grown and bores in black oak.

The stout, white naked caterpillars of poplar carpenter worm, *Cossus centerensis* Lintn., are about 1½ inches long when full grown and bore in poplar trunks. The grayish black-marked moth with a wing spread of 2 to 2½ inches harmonizes so closely with poplar bark that it is very difficult to detect.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 439, 476–477.

Sesiidæ, clear-winged moths or sesiids.

These moths are remarkable on account of their resemblance to bees and wasps, owing to the wings being mostly transparent and also to marvelously close resemblances in color patterns. These insects are of moderate to rather small size and with narrow fore-wings.

The naked white caterpillars bore in the stems, trunks, roots or branches of many living trees and plants.

Memythrus asilipennis Boisd. is a large, brownish yellow-marked, yellow-banded moth with a wing spread of 1½ inches, the whitish caterpillars of which bore in ash and alder.

The golden yellow and black, wasp-like clear-wing, *Memythrus simulans* Grote, has a wing spread of 1½ inches and is recorded as being very injurious to red oak in Minnesota, the moths appearing from the end of May and throughout the month of June, some trees harboring hundreds of borers in the trunks and limbs. It is a widely distributed species.

Three-banded clear-wing, *Memythrus tricinctus* Harris, is a black moth with three conspicuous yellow bands on the abdomen and a wing spread of about 1 inch. The larva works in the trunks of willows and poplars and has been reared from the galls produced by *Saperda concolor* Lec.

Ægeria apiformis Clerck, a large, brown, yellow-marked clear-wing moth, has a wing spread of 1¾ inches. The larvæ work in the roots of willow and poplar.

Ægeria tibialis Harris is a large, brown, yellow-marked, clear-wing moth with a wing spread of 1¾ inches. The larva works in the trunks of willow and poplar. It ranges across the northern United States.

Sesia bolteri Hy. Edw. is a steel-blue clear-wing moth with a broad scarlet-red abdominal band and red fore-wings. The larvæ bore in willow canes.

The whitish caterpillars of *Sesia albicornis* Hy. Edw., a blue-black clear-wing moth with a wing spread of ⅞ inch, bore in the trunks and branches of young willows growing in swampy places and has also been reared from burrows of the mottled willow borer, *Cryptorhynchus lapathi* Linn. It is a widely distributed species.

The whitish caterpillars of the purplish-black, yellow-marked, red-tailed clear-wing moth, *Sesia corni* Hy. Edw., with a wing expanse of about ¾ inch, bore in the branches and twigs of maple, often producing rough bark or gnarled excrescences. This attack frequently causes branches to die or weakens them so they are broken by winds.

The whitish boring caterpillars of *Sesia pictipes* Gr. and Rob., a blue-black clear-wing having a wing spread of about 1 inch and with several yellow bands on the abdomen and legs, work under the bark of plum and cherry, both wild and cultivated, juneberry and chestnut. The moths are in flight during June and July.

Sesia rubristigma Kellicott is a black, clear-winged moth with red-spotted wings and yellow-banded legs and abdomen. It is about ¾ inch long and has been reared in June and July from the horned oak gall, *Andricus cornigerus,* on *Quercus palustris.*

The dogwood appears to be the favored food plant of *Sesia* *scitula* Harris. The whitish caterpillars of this bluish-black clear-wing, some ¾ inch long and with yellow-banded legs and abdomen, work under the bark of chestnut and dogwood and are also found in the horned oak gall, *Andricus cornigerus.*

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 437–473.

Pyralidæ, pyralids.

This family includes a large number of moderate or small moths varying greatly in appearance. A considerable series of species are well-known grass-feeders. Some are borers in stems of various plants and one is a rather common pine borer noticed elsewhere.

Young brownish spruce cones are sometimes infested with a red-headed brownish caterpillar about ⅝ inch long, the spruce cone-worm, *Dioryctria reniculella* Grote, the infested cones being disfigured with a mass of webbed excreta. Occasionally a bunch of cones is webbed together and partially concealed by the accumulated débris.

Barberry pyralid, *Omphalocera dentosa* Grote, has blackish white-spotted caterpillars about 1½ inches long when full grown which occur in late summer within excrement-filled webs on barberry.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, p. 684.
1911, Britton, W. E., Econ. Ent. Journ. 4 : 521–524.

Tortricidæ, leaf-rollers.

The moths of leaf-rollers are usually small or moderate sized and have broad, squarely cut fore-wings, the anterior margins of which are usually arched toward the base. Brownish-gray and golden are common colors.

The free-living caterpillars usually roll the leaves and generally wriggle rapidly and drop upon the least disturbance. There are also a number of stem- and root-borers and some which feed in seeds and growing fruits.

The greenish black-headed caterpillars of rose bud-worm, *Olethreutes nimbatana* Clem., are about ½ inch long and bore in rose buds or web together the leaves. The first brood appears in early spring and the moths of the second may be found abroad early in June. There are two and possibly three generations about Albany and three or even four in the District of Columbia.

Rose tips blackened and tightly webbed together in early spring with glistening white silk may contain greenish larvæ about ½ inch long, which feed on the growing points and not only blacken and distort the young leaves but in many cases blast the incipient flower-buds. There are three generations of rose leaf-tier, *Olethreutes cyanana* Murtf., in Missouri, and locally fully 20 per cent of the buds, especially the white or light-colored varieties, may be destroyed.

Douglas fir cone moth, *Cydia pseudotsugana* Kearf., has a reddish larva about ¾ inch long when full grown, which is very injurious to the seeds of Douglas fir in Montana and possibly to the seeds of Englemann spruce in Montana. An unidentified species destroys the seed of western yellow pine.

The yellowish-green, brown-headed, sparsely haired caterpillar a little over ½ inch long of *Cenopis pettitana* Rob. occurs on oak and rose. This species may invade greenhouses and possibly destroys rose buds.

The black-headed yellowish-green caterpillars of *Archips fervidana* Clem. (Fig. 245), which are nearly an inch long when full grown, occur in thick webbed nests on scrub oak in early June and are occasionally somewhat abundant.

The brown-headed greenish caterpillars of oblique banded leaf-roller, *Archips rosaceana* Harr., are about ¾ inch long when full grown and occur in May and early June in the webbed leaves of a large number of trees. It has been recorded from cherry, lilac, horse-chestnut, burr oak, poplar, hazel and sumac. The moths appear the latter part of June or early in July.

The dark olive-green brown-headed caterpillars of rose leaf-folder, *Archips rosana* Linn., feed within the webbed-together leaves of rose and a number of other plants. Their habits are very similar to those of the preceding.

Fig. 245.—Archips fervidana, nest.

Ugly nest cherry worm, *Archips cerasivorana* Fitch, has yellowish black-headed caterpillars about ½ inch long. They are sometimes exceedingly abundant and may then inclose in thick masses of web most of the foliage, even of large-sized clumps of choke-cherry. Fortunately this species does not attack more valuable trees or shrubs.

V-marked leaf-roller, *Archips argyrospila* Walk., is closely related to the oblique banded leaf-roller, *Archips rosaceana* Harris. The brown-headed delicate green caterpillars about ¾ inch long when full grown feed on oak and other trees in early June and also in August or early September. They have been recorded from a variety of trees, such as hickory, apple, wild cherry, rose, soft maple and elm. There are two generations, the moths of the first appearing the last of June or early in July.

The caterpillars of pine tube builder, *Eulia pinatubana* Kearf., usually attract notice because of the peculiar cylindrical tubes of webbed-together pine needles, generally about fifteen, which occur in midsummer on white and probably other pines, the terminal third of the needles being eaten off at an almost uniform height.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 530–531, 552, 576–579, 580–581, 681–682.
1908, Cooley, R. A., Mont. Agr. Exp. Sta. Bull. 70, pp. 125–130.
1909, Sanderson, E. D., Econ. Ent. Journ. 2: 391–403.

Gelechiidæ.

A large series of small moths belong to this family, a few noteworthy because of the stem-galls they produce on various plants.

Pine leaf-miner, *Paralechia pinifoliella* Chamb., is common although ordinarily not particularly destructive. The small cylindrical, yellowish-brown larva with a dark head, thoracic shield and anal plate mines the leaves of various species of pine, causing the affected needle tips to die and turn brown. There is a very recently introduced European form, *Ocnerostoma piniariella* Zeller, which has become established in British Columbia. The work is very similar to the native species although transformations to the adult occur in a slight cocoon between the needles.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, p. 681.
1922, Felt, E. P., Econ. Ent. Journ. 15: 432–433.

Elachistidæ, case-bearers and others.

This is a large family of small usually beautiful moths. One of the largest and most important genera is Coleophora, the case-bearers, easily recognized in the immature stages by the peculiar cases which shelter the larvæ. There are also a number of leaf-miners.

Sour gum case-cutter, *Antispila nyssæfoliella* Clem., is a small miner which works in sour gum leaves the latter part of August and in early September, cutting out oval cases the latter part of that month. Occasionally it is very abundant on Long Island, although not particularly injurious.

REFERENCE

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 555–556.

Tineidæ.

Nearly all these moths are minute, with narrow wings bordered with long fringes, although there are a few species of considerable size, and broader narrowly fringed wings. The moths are often extremely beautiful.

Most of the caterpillars are leaf-miners, some being of considerable importance, such as *Bucculatrix canadensisella* Fern. noticed elsewhere. There is a considerable series of leaf-miners, only a few of which are mentioned here.

Oak leaves frequently have the foliage seriously disfigured by the irregular, whitish, blotch-like mines made by minute, footless, brownish and yellowish larvæ of white-blotched oak leaf-miner, *Phyllonorycter hamadryella* Clem. The work is most conspicuous toward the end of the season. Collecting and burning infested leaves aids in controlling the insect.

A poplar leaf-miner, *Phyllonorycter tremuloidella* Braun, has been recorded recently as severely injuring poplars in Idaho.

The light green or whitish larvæ of cypress moth, *Argyresthia cupressella* Walsin., have a reddish dorsal spot on the eighth segment and are nearly ½ inch long when full grown. They burrow into Monterey cypress tips, causing them to enlarge and finally die. The eggs are laid singly in May upon the small terminal twigs, the larvæ attacking the twigs and boring downward for about an inch. There are apparently two generations annually in California.

References

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 532–533.
1915, Essig, E. O., Inj. Ben. Ins. Cal., pp. 453–454.

Diptera

True Flies

The true flies are mostly moderate-sized to small two-winged insects, the wing-veins being usually relatively few. The metamorphosis is complete.

There are a large series of insects in this group, most of them relatively unimportant as enemies of forest trees. The gall-making midges, Itonididæ, cause many deformations in various plants but ordinarily are not especially injurious. Species belonging to a few other genera have also developed the gall-making habit. Flies are of most importance on account of their carrying pollen from plant to plant, including trees, and as predaceous or parasitic enemies of other insects, such as the flower-flies or Syrphidæ and the Tachinidæ, the last including many very efficient natural checks on the development of various insects.

Itonididæ, gall-midges.

The gall-midges are small slender flies, usually with broad wings, long antennæ and legs and are represented in America by a very large number of species, some 1,000 or more. They produce a great variety of vegetable deformations known as galls and may be reared from many different plants. The larvæ of a few species prey on other insects. The maggots of gall-midges are usually moderately stout, yellowish and may be distinguished easily by the brownish breastbone and their leaping habits.

Syrphidæ, flower-flies.

The Syrphidæ are small to rather large usually brightly colored flies banded with yellow on a black, bronze or blue ground. These sun-lovers feed on honey and pollen and occur commonly about flowers. The maggots are moderate in size, generally wrinkled and not infrequently varicolored. They are best known on account of their preying on plant-lice and are among the more efficient checks on these very prolific pests.

Tachinidæ, Tachina flies.

The insects resemble house flies, flesh flies and to a less extent blue-bottle flies, although they are much more bristly,

FIG. 246.—Tachinid fly and portion of caterpillar showing the oval, white eggs.

as a rule. Most of the Tachina flies (Fig. 246) are parasitic and hence beneficial in checking insect outbreaks. Occasionally 98 or 99 per cent of the caterpillars of such a pest as the forest tent-caterpillar may be destroyed by flies belonging to this family. Some of the adults lay their eggs directly on their prey, others deposit eggs upon the leaves and still others living maggots—striking illustrations of the variations in habit among very similar and to many apparently identical insects.

Hemiptera

True Bugs, Aphids and Scale Insects

This order includes large series of extremely varied insects which agree in having the mouth-parts developed for sucking, the possession of four wings, the anterior pair in one suborder thickened at the base and the thinner extremities overlapping; the metamorphosis is incomplete.

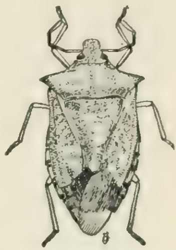

Fig. 247.—Spined soldier bug, enlarged.

This group is of interest to foresters largely on account of the leaf-hoppers and tree-hoppers, the aphids or plant-lice (see page 133), and the scale insects (see page 146), the last named departing so widely from the normal that their relation to other Hemiptera is not readily ascertained.

Pentatomidæ, stink bugs.

These are moderate-sized, usually somewhat angular, sometimes triangular, flattish bugs most easily recognized by their dull yellowish, gray or darker colors and nauseous odor, in this latter respect approaching in offensiveness the well-known squash bug of the garden. A number of species occur somewhat commonly upon trees, several at least being predaceous.

Fig. 248.—Ring-legged tree-bug, enlarged.

Soldier bugs, Podisus (Fig. 247), and Euschistus, comprise a number of similar, somewhat triangular, variably brownish and yellowish marked insects ranging in length from about $\frac{3}{8}$ to nearly $\frac{1}{2}$ inch, found about the tents of the common apple-tree tent-caterpillar, *Malacosoma americana* Fabr., and wherever various leaf-caterpillars are somewhat numerous. These insects have a marked odor and are commonly known as stink bugs. They prey on the young of various smaller insects and are consequently beneficial.

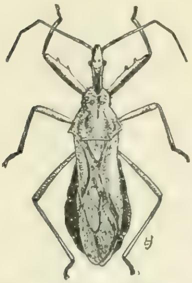

FIG. 249. — Spined assassin bug, enlarged.

Ring-legged tree-bug, *Brochymena annulata* Fabr. (Fig. 248), is a dark grayish, rather broad insect about 5/8 inch long which occurs from midsummer to the end of the season and probably in early spring on various trees. It is recorded as injuring twigs and limbs. Two closely related species, *B. quadripustulata* Fabr. and *B. arborea* Say, presumably have similar habits.

REFERENCE

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 588–591, 607–613.

Reduviidæ, assassin bugs.

These are long-legged bugs, some at least having the anterior pair of legs enlarged and adapted to grasping or seizing the prey. The head is narrow, the eyes small and prominent and there is a very short stout thorax. These bugs prey on other insects and are, therefore, beneficial.

Acholla multispinosa DeGeer (Fig. 249) is a light to dark brown insect about 1/2 inch long which preys on various leaf-feeders in much the same way as the soldier bugs. It is easily recognized by its slender form and the somewhat conspicuous spines upon the fore legs.

REFERENCE

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 613–614.

Membracidæ, tree-hoppers.

The tree-hoppers are represented by a large number of species common on the twigs of various trees and shrubs. These insects are moderate in size, rarely ½ inch long, and present many extremes in form, particularly in angular or horn-like projections of the prothorax. The spiny odd-shaped young or nymphs are equally grotesque.

Two-marked tree-hopper, *Enchenopa binotata* Say, is a brownish-black insect with an enormous horn-like projection over the head. It occurs in the fall on a number of plants. The egg covering is a snow-white frothy mass about 3/16 inch long and ⅛ inch broad, and in earlier years was mistaken for a scale insect (Fig. 250). This species breeds in large numbers on the shrubby bittersweet, *Celastrus scandens*, although it has been recorded from a number of other plants. Adults and young occur during July and August and a group at that time somewhat resembles a flock of young and old partridges in miniature.

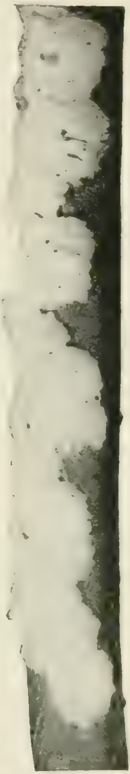

Fig. 250.—Two-marked tree-hopper, egg masses.

Buffalo tree-hopper, *Ceresa bubalus* Fabr., is a grass-green, triangular, two-horned bug about ⅜ inch long which occurs the latter part of the summer on a number of trees and shrubs. The principal loss results from the scars made in the smaller twigs and branches when the eggs are deposited in two parallel rows just under the bark. This injury frequently causes a considerable swelling and interruption in the normal circulation, even if it does not permit the entrance of injurious fungi.

Thelia acuminata Fabr., *T. godingi* Van Duz. and *Cyrto-*

lobus fenestratus Fitch (Fig. 251) are related tree-hoppers worthy of mention, since they typify various forms in this large and interesting group.

REFERENCE

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 591–597.

Cercopidæ, spittle insects.

Masses of frothy-like spittle on pine indicate the presence underneath of small, stout, triangular or rounded dull-colored

FIG. 251.—Three tree-hoppers: Thelia acuminata, T. godingi and Cyrtolobus fenestratus, from left to right, all enlarged.

bugs. Several of these interesting species occur on pines. Saratoga spittle insect, *Aphrophora saratogensis* Fitch, is a uniform brownish color, variegated with light brown or yellow. It is about 3/8 inch long and more slender than the following. Adults occur from the last of June to the end of September.

FIG. 252.—Obtuse Clastoptera, enlarged.

Parallel spittle insect, *Aphrophora parallela* Say, is about 1/2 inch long and may be recognized easily by the whitish spot in the center of each wing-cover and by the smooth whitish line along the dorsum of the head and prothorax. It is sometimes common on hard pine in July.

Quadrangular spittle insect, *Aphrophora* *quadrangularis* Say, prettily oblique banded, $\frac{1}{4}$ inch long, occurs in small numbers on hard pine in August and September.

Pine clastoptera, *Clastoptera pina* Fitch, is a stout oval blackish tree-hopper, $\frac{1}{6}$ inch long, the young occurring on pines in early June.

Obtuse clastoptera, *Clastoptera obtusa* Say (Fig. 252), is a small species ranging from $\frac{1}{8}$ to $\frac{3}{16}$ inch in length and is irregularly marked with yellowish-brown and yellowish-white. It occurs during June and is remarkable for its short, stout, obtuse shape.

REFERENCE

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 686–687.

Fulgoridæ, lantern flies.

This family is best known by the great lantern fly of Brazil and the peculiar candle flies of China and the East Indies, both monstrous and bizarre forms. The native species are moderate to small-sized insects and with relatively little suggesting relationship to the above-mentioned exotic species.

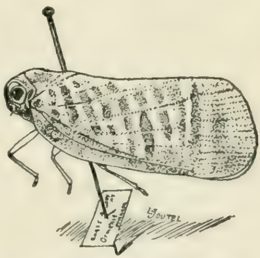

FIG. 253.—Lightning leaf-hopper, enlarged.

Lightning leaf-hopper, *Ormenis pruinosa* Say (Fig. 253), is an active little insect something over $\frac{1}{4}$ inch long and may be recognized easily by the whitish covering of its dark purplish or brownish wings and the long flocculent masses of woolly matter dropping from the young. Both are very active and occasionally extremely abundant on viburnum and other ornamentals.

REFERENCE

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, p. 598.

Tingitidæ, lace bugs.

There are a number of these small bugs, the expanded thoracic margins and the fore-wings being very suggestive of lace drapings, hence the common name. These sucking insects are rarely more than ⅛ inch long. The young are peculiar on account of the numerous spines, and the eggs of a number of species resemble miniature black volcanoes upon the leaves. A severe infestation by insects belonging in this group usually results in a black-specked, yellowish-spotted, unhealthy condition of the foliage. For a general account of these interesting insects, see Barber, H. G., and Weiss, H. B., 1922, N. J. Dept. Agr., Bur. Statis. and Insp., Circ. 54, pp. 1–24.

FIG. 254. — Hawthorn tingis, enlarged.

Hawthorn tingis, *Corythuca arcuata* Say (Fig. 254), is a minute net-veined insect about ⅛ inch in length. It is very beautiful when examined under a microscope. Adults and young may be found on the underside of the leaves of thorn and oak during the summer. The blackish eggs resemble small truncated cones attached to the under surface of the foliage. A closely related species, *Corythuca ciliata* Say, occurs on the underside of the foliage of button-wood or sycamore during midsummer.

REFERENCE

1906. Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 598–600.

Psyllidæ, jumping plant-lice.

These active insects are usually small, rarely more than ⅛ inch long, and generally occur in numbers on favored plants, the (miniature) cicada-like adults with their somewhat numerous wing-veins jumping and flying readily. A large number of species is known, although comparatively few are sufficiently abundant to be of noteworthy importance.

Bramble flea-louse, *Trioza tripunctata* Fitch (Fig. 255), a small reddish-brown jumping plant-louse ⅛ inch long, is sometimes abundant on hard pine the latter part of the season and early in the spring. The immature stages are known to develop on blackberry, the adults hibernating.

Fig. 255.—Bramble flea-louse, enlarged.

Minute, black, narrowly white, fringed bodies less than $\frac{1}{25}$ inch long on twigs of *Rhus glabra* in the fall and suggestive of scale insects may be the immature stages of this jumping plant-louse, *Calophya flavida* Schwarz.

References

1904, Schwarz, E. A., Ent. Soc. Wash. Proc. 6 : 243.
1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 688–689.

Orthoptera

Grasshoppers and Allies

The moderate to large-sized insects in this order are best known through the numerous grasshoppers which sometimes swarm, especially in sandy areas where there is a sparse vegetation. Occasionally these insects, driven by shortage of grasses and other normal provender, attack trees, even gnawing the bark and causing serious injury. This latter development is somewhat uncommon. Swarms of grasshoppers may be greatly reduced by the use of poisoned baits. (See page 22.) The bizarre walking-sticks and the whitish tree crickets as well as the true crickets are also placed in this group.

Walking stick, *Diapheromera femorata* Say (Fig. 256), is a slow-moving green or brown stick-like insect, sometimes measuring, exclusive of the antennæ, 3 inches in length. It occurs in small numbers in forest areas, although occasionally becoming extremely abundant. The young insects are green and closely resemble the color of the foliage, the nearly full grown ones toward the end of the season assuming a brown color, which harmonizes very closely with the tints of the twigs of oak and other food plants.

FIG. 256.—Walking stick resting on small twigs.

White flower cricket, *Oecanthus niveus* DeGeer, is a delicate pale greenish or whitish insect about ¾ inch long, occurring from the middle of August to the latter part of September on various herbs, shrubs and trees. These flower or tree crickets are beneficial in that they feed on a variety of smaller insects, such as plant-lice, and injurious on account of their depositing eggs in the twigs and canes of various trees and shrubs, such as apple, grape, cherry, oak, elm, hazel, sumac and willow. These oviposition scars afford ready entrance for fungus diseases, which latter sometimes produce serious results.

Several of these pale green pine tree crickets, *Oecanthus* spp., may be found on pines in midsummer and later. They resemble each other closely and are distinguishable most easily by differences in the black markings at the base of the antennæ, the three species being *O. pini* Beutm., *O. nigricornis* Walk., and *O. quadripunctatus* Beutm.

Reference

1906, Felt, E. P., N. Y. State Mus. Mem. 8, vol. 2, pp. 533–535, 602–603, 698–699.

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